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telecommunication journal

OFFICIAL ORGAN OF THE INTERNATIONAL TELECOMMUNICATION UNION

Journal des Télécommunications
Boletín de Telecomunicaciones

FEBRUARY 1962

Vol. 29 — No. 2

In this issue :

ANDREW G. HALEY
Space communications of the next generation

C. S. LAWTON
Fishing versus cables

CARL W. LOEBER
Administrative Radio Conferences—time for a change?

Telepersonality
No. 14—Sir Edward Appleton

ANTENNA ON THE SÄNTIS STATION (SWITZERLAND) IN WINTER

(Photo: Swiss PTT) →

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the operator's delight

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Private automatic branch exchanges are becoming an increasingly indispensable link between the internal and external communications of businesses large and small. They are often the deciding factor in promoting a rapid interchange of ideas and data between staff members and efficient and pleasant relations with the telephoning public.

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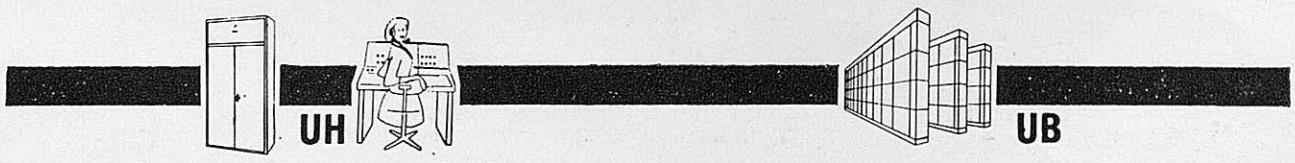

an advertisement in Philips KEY CAPITALS series

telex service telex service telex service telex service telex
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telex service telex servi el
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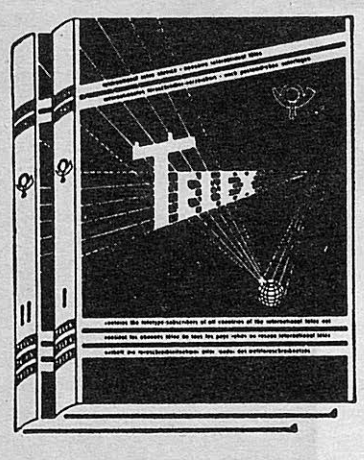
INTERNATIONALES FERNSCHREIBER-VERZEICHNIS ist ein Handbuch für die reibungslose und schnelle Abwicklung des Telexverkehrs. Es ist das zuverlässige Verzeichnis der Fernschreibteilnehmer aus 59 Ländern der Erde und enthält über 77 000 genaue Adressen. Unser INTERNATIONALES FERNSCHREIBER-VERZEICHNIS ist bearbeit nach den amtlichen Informationen der am internationalen Telexverkehr beteiligten Postverwaltungen und Telegrafengesellschaften in allen fünf Kontinenten. Für Deutschland hat der Verlag das Alleinrecht zur Auswertung der amtlichen Unterlagen der Deutschen Bundespost. So ist die Gliederung der zweibändigen Plastikausgabe : Band I dient dem abgehenden Fernschreibverkehr. In seinem Teil I sind die Firmennamen alphabetisch geordnet. Sein Teil II, nach Orten unterteilt, führt innerhalb der Orte die Firmen alphabetisch auf. Band II entschlüsselt die Namengeber der ankommenden Fernschreiben. Durch das Einheits-Alphabet kann jeder Absender eines Fernschreibens sofort festgestellt werden ; gleichgültig, aus welchem Land das Fernschreiben kommt.

INTERNATIONAL TELEX-SERVICE is a handbook ensuring promt and smooth handling of telex messages. This reliable directory of telex-subscribers of 59 countries contains more than 77 000 exact addresses of telex-subscribers. Our INTERNATIONAL TELEX SERVICE is compiled from official information supplied by the Postal Administrations and Private Cable Companies of all five continents. For the German part : sole right to use official records of the Federal Post Authorities. Here is how it looks like : Two plastic coated volumes. Volume I for outgoing telex messages : All addresses in alphabetical order. In part I by names and in Part II by places and by names. Volume II for incoming telex messages : The alphabetical list of the answer-back codes with the country indicated, containing all telex-subscribers of 59 countries. So every telex-subscriber is able to identify immediately the sender of a telex message whichever the country of origin may be.

ANNUAIRE INTERNATIONAL TELEX est un manuel créé pour permettre des communications télex rapides. C'est un répertoire éprouvé des abonnés télex répartis sur 59 pays du monde et contenant plus de 77 000 adresses exactes. Notre ANNUAIRE INTERNATIONAL TELEX est mis au point conformément aux renseignements officiels qui nous sont fournis par les administrations des PTT de cinq continents. En République fédérale, l'éditeur est habilité à titre exclusif à utiliser les documents officiels de la Poste fédérale allemande. L'ouvrage se compose de 2 volumes sous reliure plastique : Le volume N° I sert au départ des communications télex. Dans sa première partie les entreprises sont classées par ordre alphabétique. Sa deuxième partie comporte un classement géographique qui prévoit le recensement des entreprises alphabétiquement à l'intérieur de leur domiciliation. Le volume N° II donne la liste des indicatifs des abonnés. Grâce à l'ordre alphabétique de ceux-ci, tout expéditeur d'un message télex peut être aussitôt retrouvé quel que soit le pays dont le message provient.



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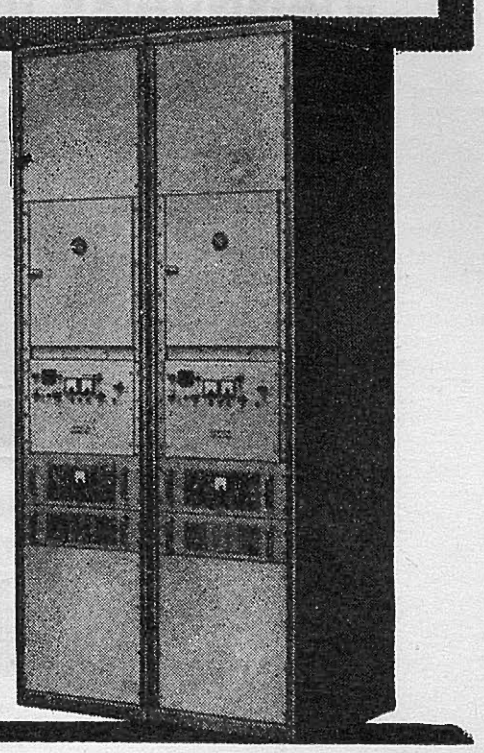
Portable and Fixed Station Equipment for

MICROWAVE TELEVISION LINKS



For the transmission over long distances of complete television programmes via a number of links, the Pye P.T.C. M1000 equipment provides portable or fixed units for simultaneous radiation in the microwave band of vision and audio signals. Effective communication can be maintained over 50 miles or more per link, with only one watt of power. Frequency ranges are available between 5925 Mc/s and 7500 Mc/s, with excellent frequency stability. In portable form each unit is conveniently carried in luggage type cases and is easily assembled on site. Adaptors for 19-inch rack mounting are available for fixed station applications.

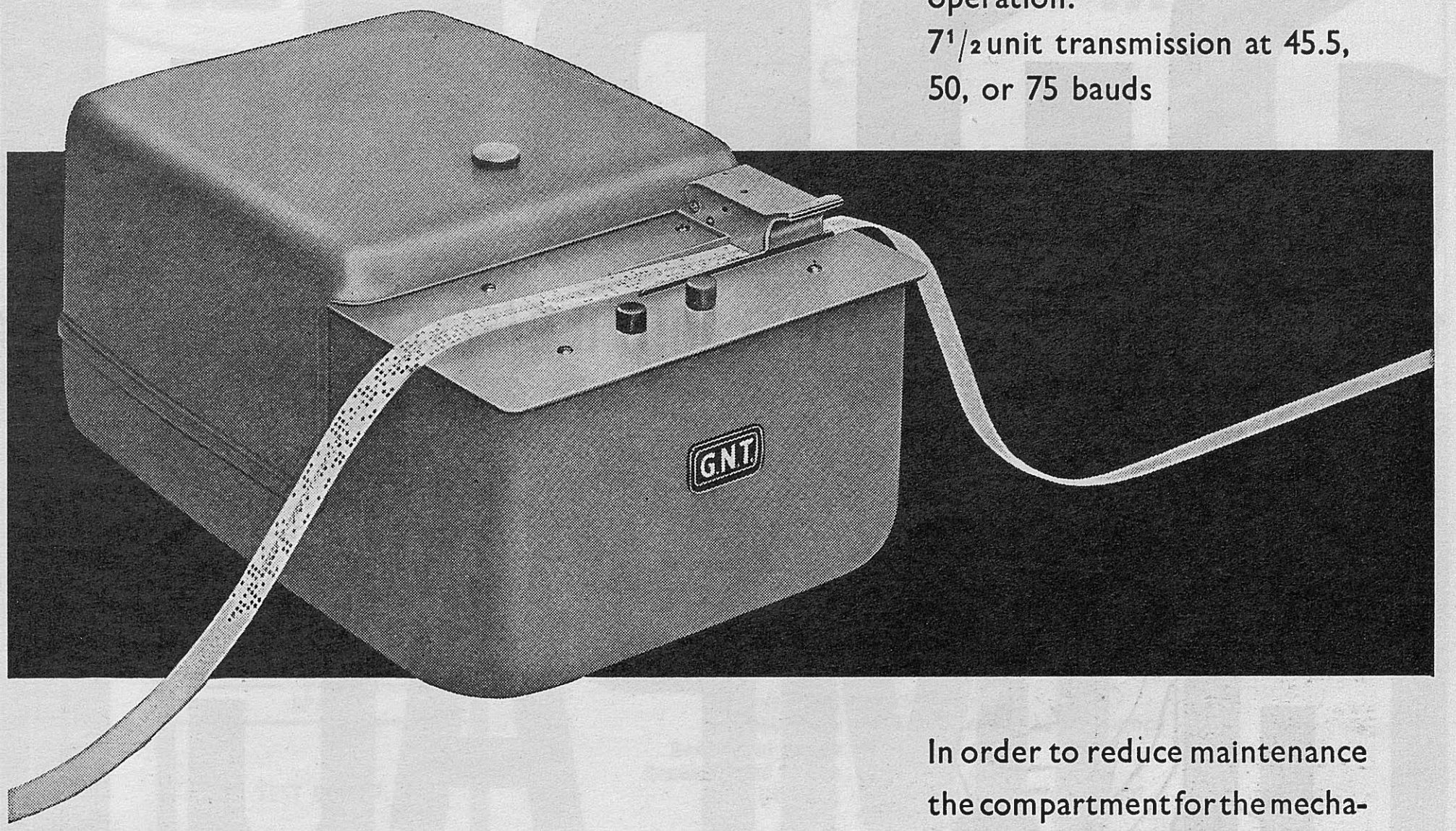
PYE TELECOMMUNICATIONS LTD., CAMBRIDGE, ENGLAND

G.N.T.

5-unit tape transmitter

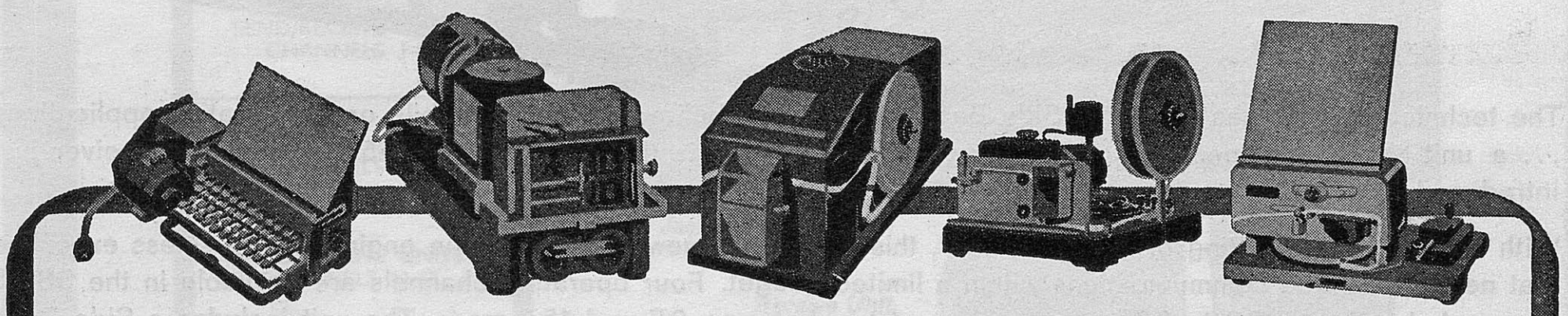
model 20

Sequential type for single wire transmission.
For single or double current operation.
7 1/2 unit transmission at 45.5, 50, or 75 bauds



Meets all the requirements of a modern 5-unit tape transmitter.

In order to reduce maintenance the compartment for the mechanism is pressurised so that dust and paper fluff cannot enter the operating parts.



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SSB-5

125 WATT SINGLE-SIDEBAND MOBILE/FIXED TRANSCEIVER

COMPACT

The technical advantages of Single Side Band at a price unbelievably low . . . mobile or fixed station applications . . . a unit that is compact, rugged and versatile . . . all this is the brand-new SSB-5 Compact Transceiver just introduced by RCA.

With a power output rating of 125 watts PEP, this unit opens new horizons to the engineer or business executive that needs extended communications within a limited budget. Four operating channels are available in the SSB-5 Compact; two in the 3.0 to 6.7 mc/s. range and two between 6.7 and 15.0 mc/s. The unit includes a Side Band Selector that allows operation on either upper or lower Side Band when equipped with the appropriate filters.

For more information write to: **Dept. Y-28,** RCA International Division, 30 Rockefeller Plaza, New York 20, N. Y.

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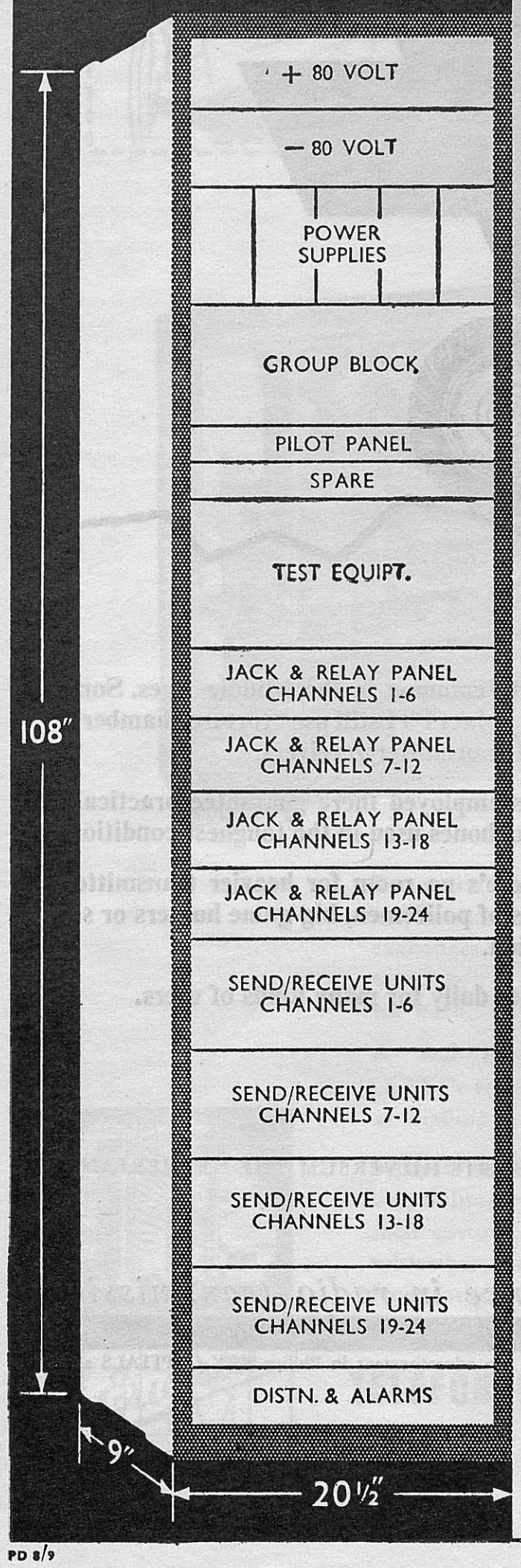
Minimum power consumption . . . .

Minimum maintenance . . . .

AEI Transistorised FMVFT

TYPE CT 24A

FOR THE PROVISION OF TELEPRINTER OR DATA TRANSMISSION CIRCUITS



* CCITT standards of performance
* 24 channels per rackside
* 50 baud nominal, with operation up to 80 bauds
* Plug-in units
* Optional in-built test equipment comprising:—
  a) Telegraph test set
  b) Level measuring set
  c) Frequency check unit
* Completely self contained with all power supplies
* Pilot facility 300 c/s or 3300 c/s

24 frequency modulated channels are provided in the nominal frequency band 420-3180 c/s with 120 c/s separation between adjacent channels. These are built up from 4 sub-groups of 6 channels each in the frequency band 1140-1740 c/s. Compactly assembled plug-in units use printed circuit wiring boards with small encapsulated filter and transformer units. Equipment is protected by bay covers, but test equipment and jackfields are directly accessible at centre of rack.

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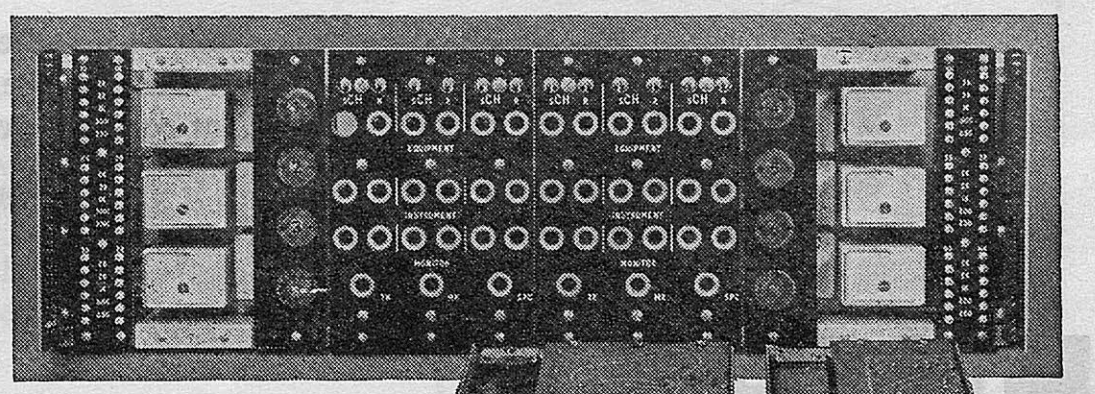
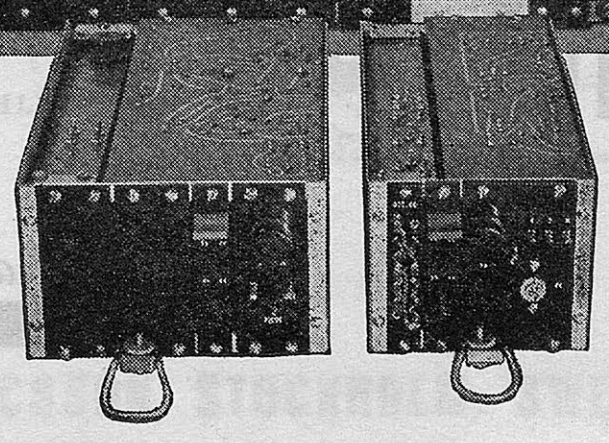
Deviation	± 30 c/s from mid frequency
Send level range	–15 to –35 dBm
Receive level range	–15 to –35 dBm
DC lines	Send 20mA double current. Receive up to 100 mA. Balanced loop and neutral loop conditions on request.
Temperature compensated	+ 5°C to + 55°C
Power supplies	100-120v or 200-240v AC (Battery operation through an inverter as optional extra).

Details of the latest AEI Carrier Telephone and Telegraph Equipment supplied on request



Jack and Relay Panel



Receive Unit and Send Unit

AEI

Associated Electrical Industries Ltd
Telecommunications Division, Transmission Department
Woolwich, London S.E.18, England
Cables: Sieswan London

PD 8/9

best by test

Torture chambers, history tells us, were fairly common in the Middle Ages. Some people think they have disappeared since then. In fact PTI still use "torture chambers" to test their Mobilophones - mobile VHF FM transmitter/receivers.

The gruelling mechanical and electrical tests employed there guarantee practically 100% reliability, a sheer necessity for Mobilophones used in the toughest conditions.

The Mobilophone has a job to do where there's no room for heavier transmitter/receivers: in cars, on small craft, on the backs of policemen, big-game hunters or sea or river pilots. A miracle of compact perfection.

And in its various versions it performs miracles daily for many kinds of users.

PHILIPS N.V. PHILIPS' TELECOMMUNICATIE INDUSTRIE HILVERSUM THE NETHERLANDS

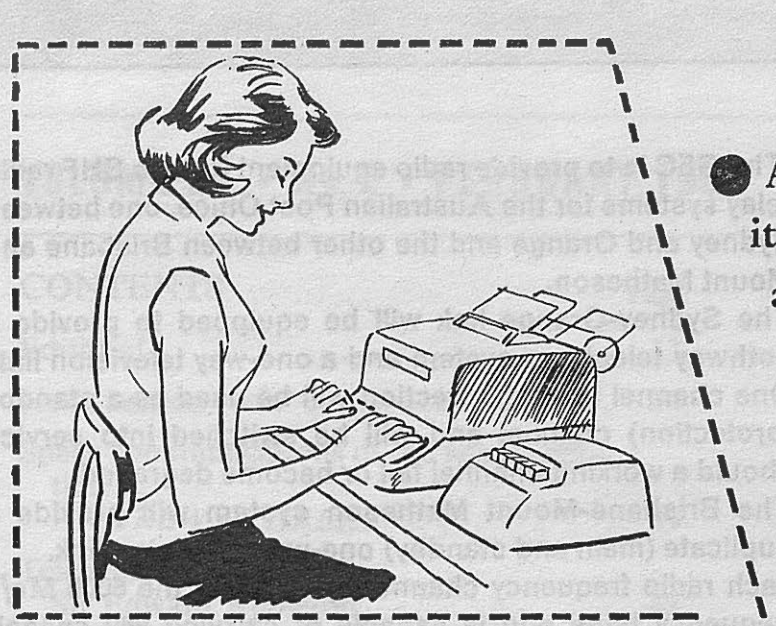
1733-E

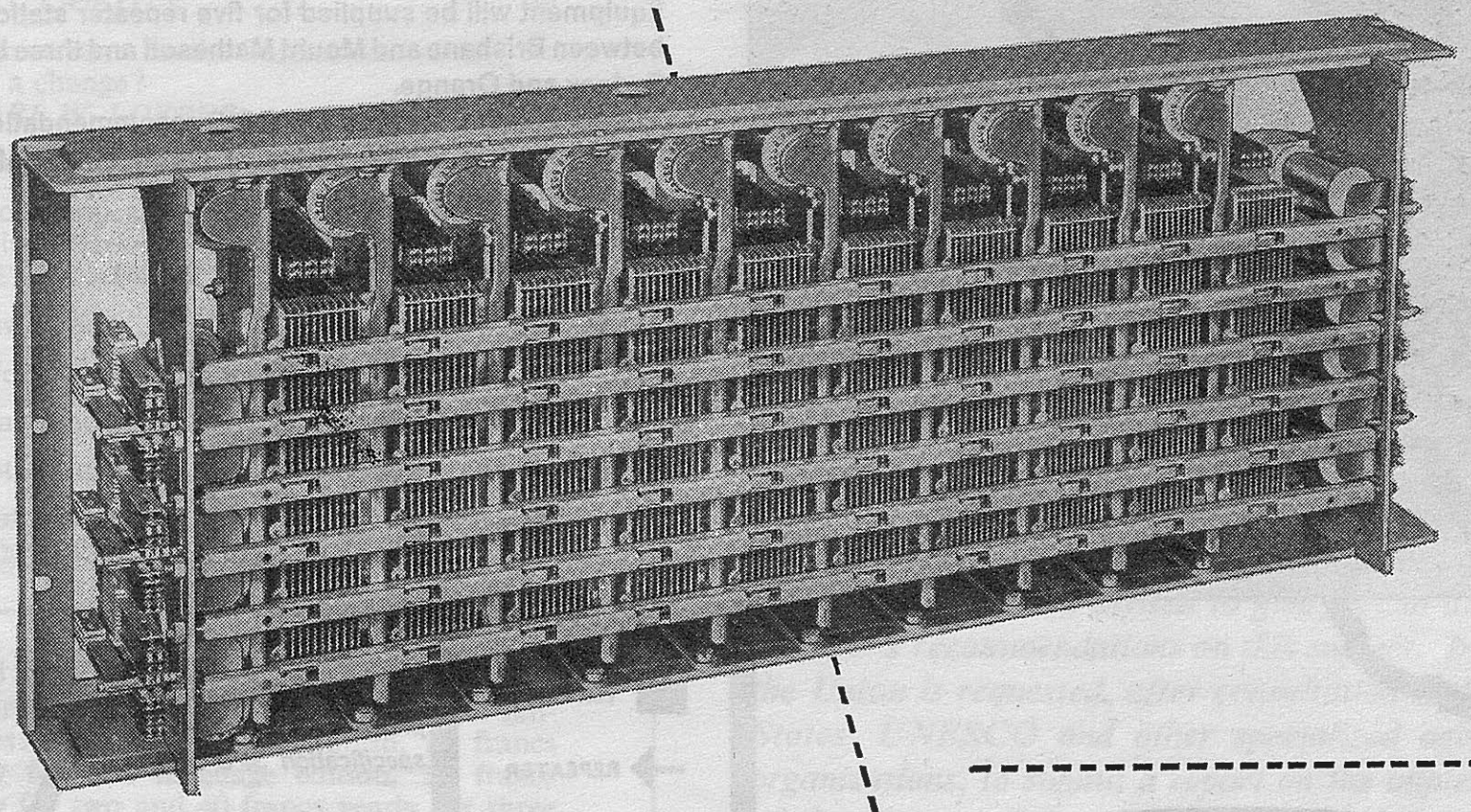
more than 40 years experience in radio transmission

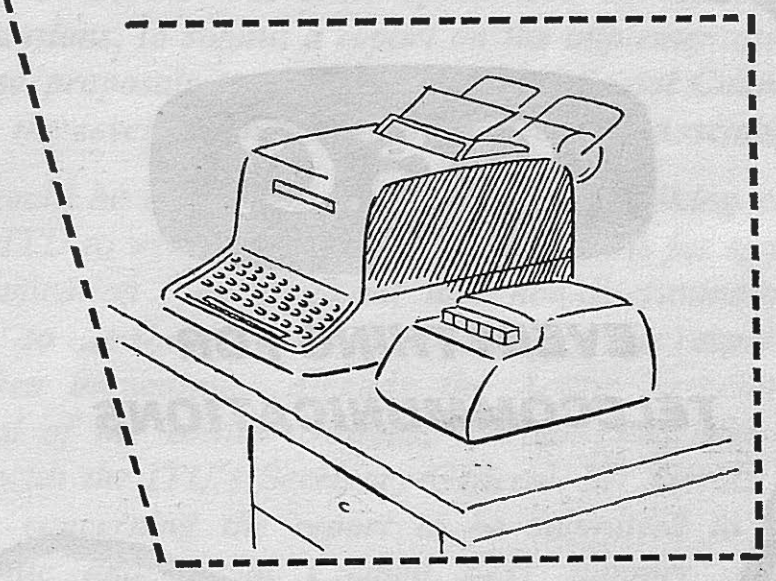
an advertisement in Philips KEY CAPITALS series

New LM ERICSSON system for TELEX exchanges

Symbol of superior engineering and imposing economy in modern telephony





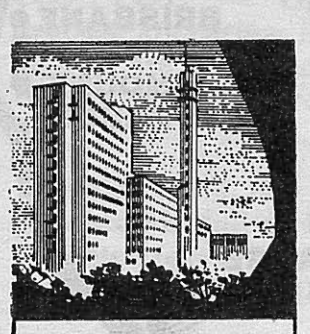


All the advantages of Crossbar Switching—speed, reliability, flexibility and low maintenance — are now available also in TELEX exchanges! Just contact L M Ericsson and you will get all information about the new system, introduced in 1960, which has met with great interest all over the world. The system has an initial capacity of 20 subscribers and can be extended in steps of 20 up to the desired number of lines.

Better economy—telex and telephone traffic can be switched through transit exchanges in which the common equipment, power supply etc. are the same for both.

A and B signalling according to CCITT's recommendation—with keying or dialling.

Separate networks not needed for police, military, banks, air services, etc.—such customers are assigned to special subscriber classes so that calls to and from other classes can be prevented.



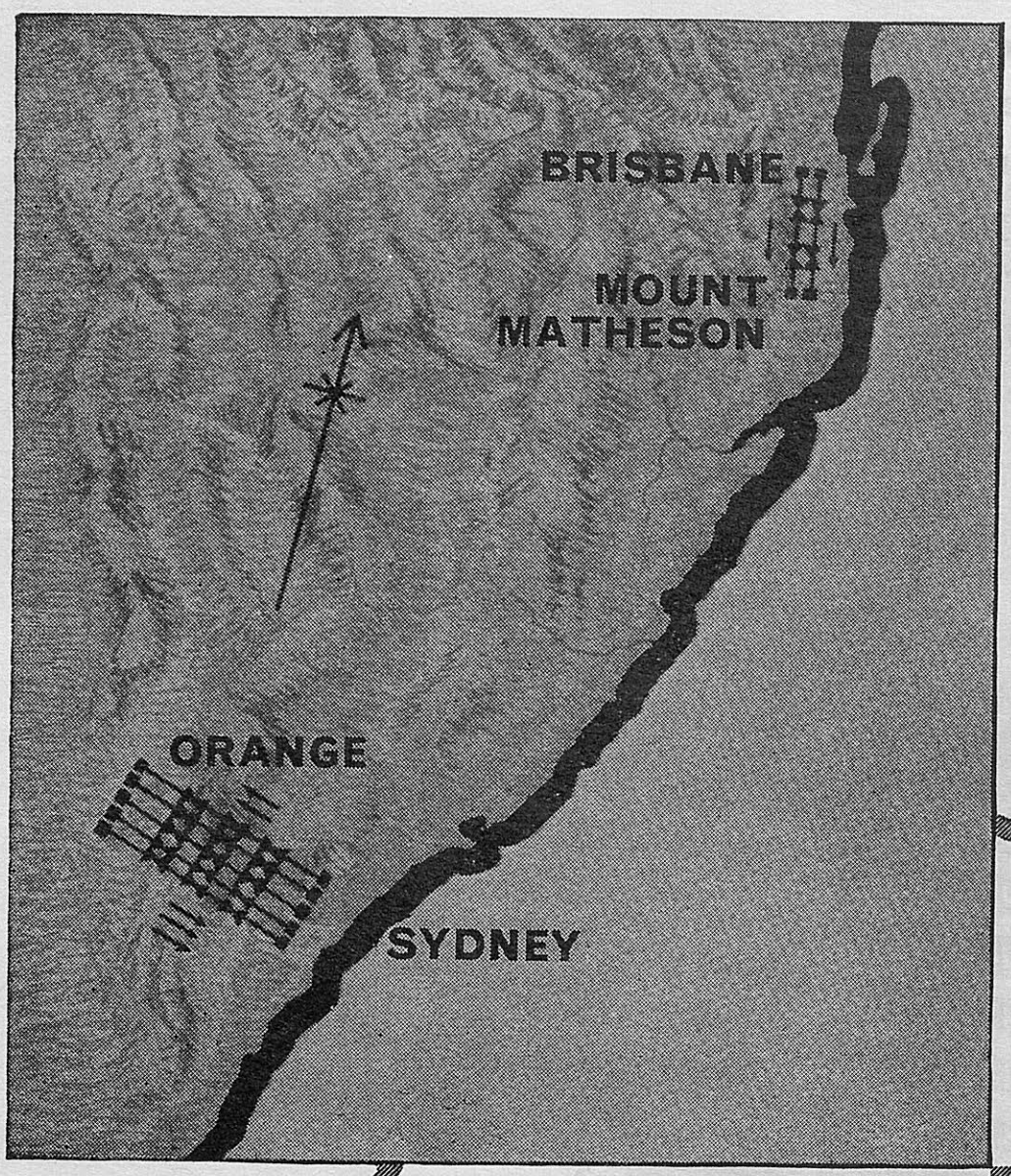
Ericsson LM

TELEFONAKTIEBOLAGET LM ERICSSON, STOCKHOLM, SWEDEN

L M Ericsson is a world-wide organization employing more than 36,000 people and is represented in 85 countries.

G.E.C.

SHF Broadband Radio Equipment comes to Australia



The GEC is to provide radio equipment for two SHF radio relay systems for the Australian Post Office, one between Sydney and Orange and the other between Brisbane and Mount Matheson.

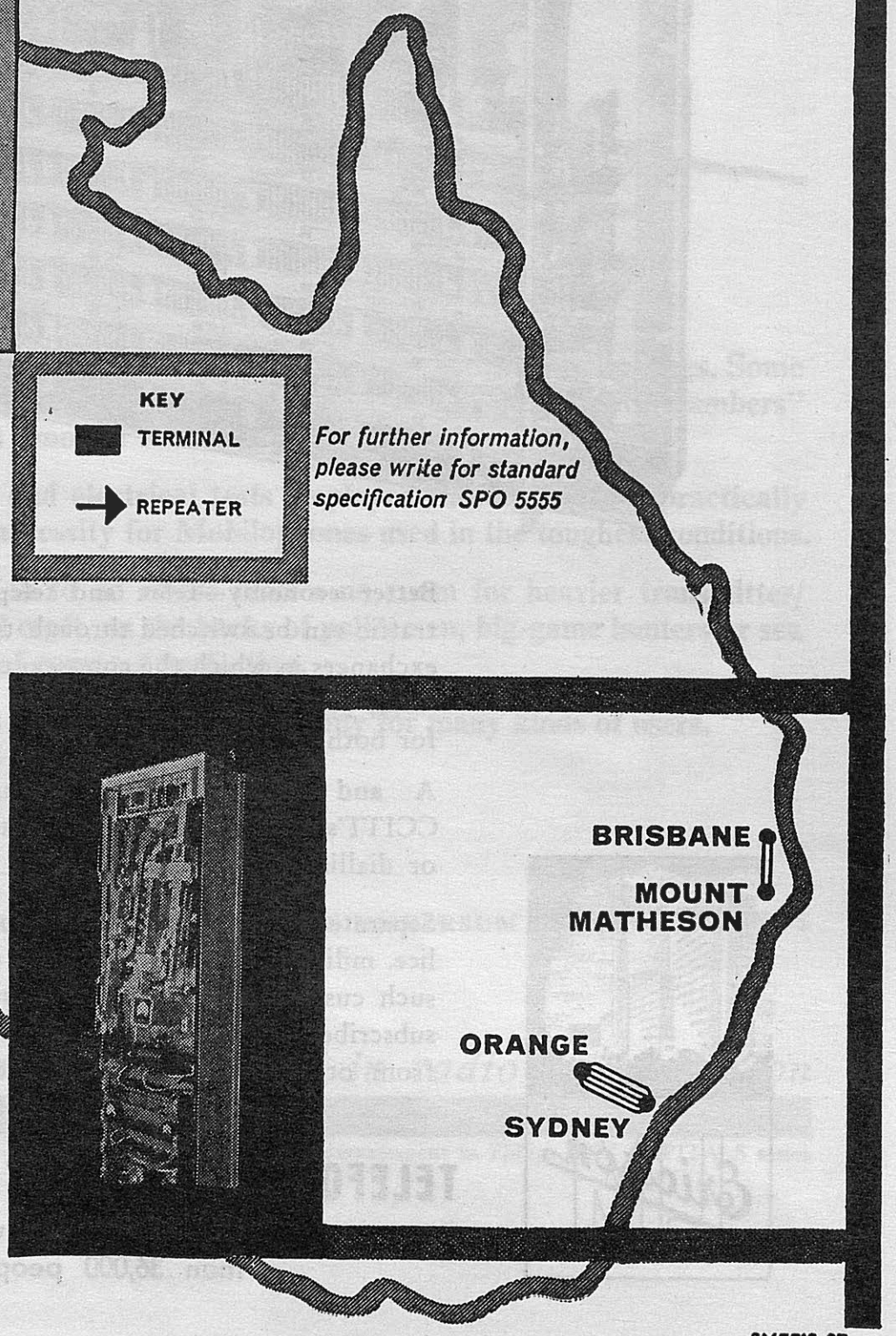
The Sydney-Orange link will be equipped to provide a bothway telephony system and a one-way television link. One channel in each direction will be used as a standby (protection) channel and will be switched into service should a working channel fail or become degraded.

The Brisbane-Mount Matheson system will provide a duplicate (main and standby) one-way television link.

Each radio frequency channel operates in the 6000 Mc/s frequency band and is capable of carrying 960 speech channels or a television programme.

Equipment will be supplied for five repeater stations, two between Brisbane and Mount Matheson and three between Sydney and Orange.

The equipment conforms to CCIR recommendations and is the latest in a long series of highly successful GEC radio equipments.



For further information, please write for standard specification SPO 5555

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57 volumes published

Telecommunication Journal (since 1934)
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THE SPACE RESOLUTION

Readers of the Journal *will have seen in the January issue—and also perhaps in their daily newspapers—the text of the resolution on the peaceful uses of outer space unanimously adopted by the United Nations General Assembly in the closing hours of its 1961 session on 20 December. The effect of this document on the future work of the Union is likely to be momentous.*

The resolution calls on the ITU to aid in the process of making satellite communication available to the nations of the world. Specifically, the scope of the ITU's space communications Conference (scheduled for 1963) is greatly widened by a recommendation that the Union consider at this Conference those aspects of space communication in which international co-operation will be required.

With a view to stepping up technical assistance in telecommunications in order that all countries may be in a position to make effective use of space communication, the Expanded Programme of Technical Assistance and the Special Fund are invited to give special attention to the ITU's recommendations on this subject. In addition, the Union is requested, after consultation with Member States, UNESCO and other specialized agencies and organizations, to submit a report on the implementation of these proposals to the Economic and Social Council and to the seventeenth session of the General Assembly.

It would be difficult to imagine a more striking call to the ITU to work out the basic requirements for space communication "on a global and non-discriminatory basis," to use the words of the resolution. The response has been immediate. Already the Acting Secretary-General of the United Nations, U Thant, has been in touch with the ITU's Secretary-General, Mr. Gerald C. Gross, concerning the report to be submitted to the Economic and Social Council next summer. And preliminary consultations with UNESCO have taken place.

The ITU was once primarily regarded as the supreme arbiter of the number of centimes per word on a telegraph form. It is being transformed to-day into a living agent of contemporary history.

C. M.

headquarters

THE MOVE...

...HAS BEGUN!

(From an eye-witness account) **In the face of rain and cold, enveloping mud, the clang of workmen's hammers and layers of debris and dust, the occupation of the new building has at last begun.**

On 30 November, a beach-head was established by the Secretary-General and some of the higher officials of his staff, thus reversing the normal order of an invasion. Skilful handling of the motorized columns bringing the office equipment prevented the lorries from being bogged down in the mud. Within hours, telephone communication was established with the outside world and sufficient essential supplies were installed.

A few reinforcements arrived at the beginning of January, but it is not expected that the main body of forces will be able to land before the beginning of March.

MEETINGS OF THE CCITT

Throughout November and December last, the International Telegraph and Telephone Consultative Committee held a whole series of meetings concerned with inter-continental telephony. All in all, more than two hundred delegates arrived in Geneva to attend them.

The first meeting was held by Study Group II (Telephone operating problems) under Mr. Terras (France). Among other conclusions of interest to our readers, the Study Group recommended that changes be made in the charging system for inter-continental telephone calls, so as to make allowance for the introduction of no-delay and semi-automatic working. Hitherto inter-continental person-to-person and station-to-station calls have been subject to the same rates, which means that most inter-continental telephone traffic is of the person-to-person kind. It is now planned to charge more for one category than for the other in relations where traffic is heavy. This change, which betokens an alignment on the exigencies of the Telephone Regulations, will coincide with a fairly substantial reduction in the unit charge for an ordinary inter-continental call.

The heaviest burden during these November-December meetings was borne by Study Group XIII (Automatic telephony. Chairman: Mr. Lambiotte, of Belgium). This Study Group was called upon to decide what operating signals were useful or essential in inter-continental working, lay down principles for the routing of inter-continental traffic, decide on a world-wide numbering plan, and consider the problem of inter-continental maintenance.

Four working parties met before the Study Group itself, each dealing with one of these items. Their meetings, together with that of the Study Group, lasted no less than three weeks (from 20 November to 8 December).

The Study Group's conclusions will provide a foundation for the labours of Study Group XI (Telephone signalling and switching). This latter, in the course of a five-day meeting, during which Mr. W. J. E. Tobin (United Kingdom of Great Britain and Northern Ireland) was in the Chair, decided on a study programme with a view to drawing up specifications for inter-continental signalling and switching equipment; in addition it studied certain problems of noise and the effect of noise on signal receivers.

Lastly, Study Group XVI, under Mr. R. H. Franklin (United Kingdom of Great Britain and Northern Ireland) met at the same time as these studies of signalling and switching problems were proceeding. This Study Group is concerned with telephone circuits, and on this occasion dealt more particularly with inter-continental working. The Working Party on inter-continental line maintenance of Study Group IV, under Mr. Billen (United Kingdom of Great Britain and Northern Ireland) met at the same time.

SPECIAL MISSION IN CENTRAL AMERICA

Mr. Jean Persin, Director of External Relations, has just come back from a special mission in Central America on behalf of the International Bank for Reconstruction and Development.

The Bank wanted to obtain information about the possibilities of financing telecommunication programmes in the Central American countries: El Salvador, Guatemala, Honduras, Nicaragua, Costa Rica, and Panama. This being a matter in which the ITU is these days interested, the Union gladly associated itself with this four-man mission. Organized by the Bank, the mission lasted five weeks.

" Our general conclusions "—says Mr. Persin—" were that Central American telecommunication systems are exceedingly backward, and urgently require development. I am using the word ' backward ' in no pejorative sense; it has to be remembered that in this age of space communications these countries, or most of them, are still almost confined to Morse telegraphy as it was a hundred years ago. Long-distance telephony is mostly carried on single iron-wire overhead lines with earth return.

" The great problem in telecommunication development is where to get the money from. There can be no doubt that the International Bank's assistance will be very welcome in these countries."

MEETING WITH UNESCO

In accordance with the request made in the United Nations General Assembly's resolution on the peaceful uses of outer space, preliminary consultations between the ITU and UNESCO were held at Union Headquarters on 11 January. Mr. E. M. Fournier d'Albe, of

the Division for Co-operation in Scientific Research, represented UNESCO, while the ITU team was headed by Mr. N. I. Krasnosselski, Chairman of the IFRB.

Various aspects of the development of space communications were discussed, including technical assistance and the use of any future satellite systems for educational purposes.

international

CANTAT—THE ANGLO-CANADIAN TRANSATLANTIC CABLE SYSTEM

On 19 December, 1961, Her Majesty Queen Elizabeth II inaugurated *Cantat*, the new trans-Atlantic telephone cable linking Canada and the United Kingdom, by making the first call to Mr. J. G. Diefenbaker, the Canadian Prime Minister, in Ottawa.

Cantat, besides being the first telephone cable to link Britain with Canada direct, is the first stage of a telephone cable system which will join many countries of the Commonwealth. The second stage will be *Compac* from Vancouver *via* Hawaii to New Zealand and Australia. This is expected to be followed by a cable from Australia to New Guinea and Singapore, with a spur to Hongkong. Further extensions of this system have still to be planned.

Cantat is the third telephone cable to be laid across the Atlantic. The big increase in transatlantic telephone traffic which quickly followed the opening of the first in 1956 and the increasing economic development of Canada led to the conclusion that another cable was necessary.

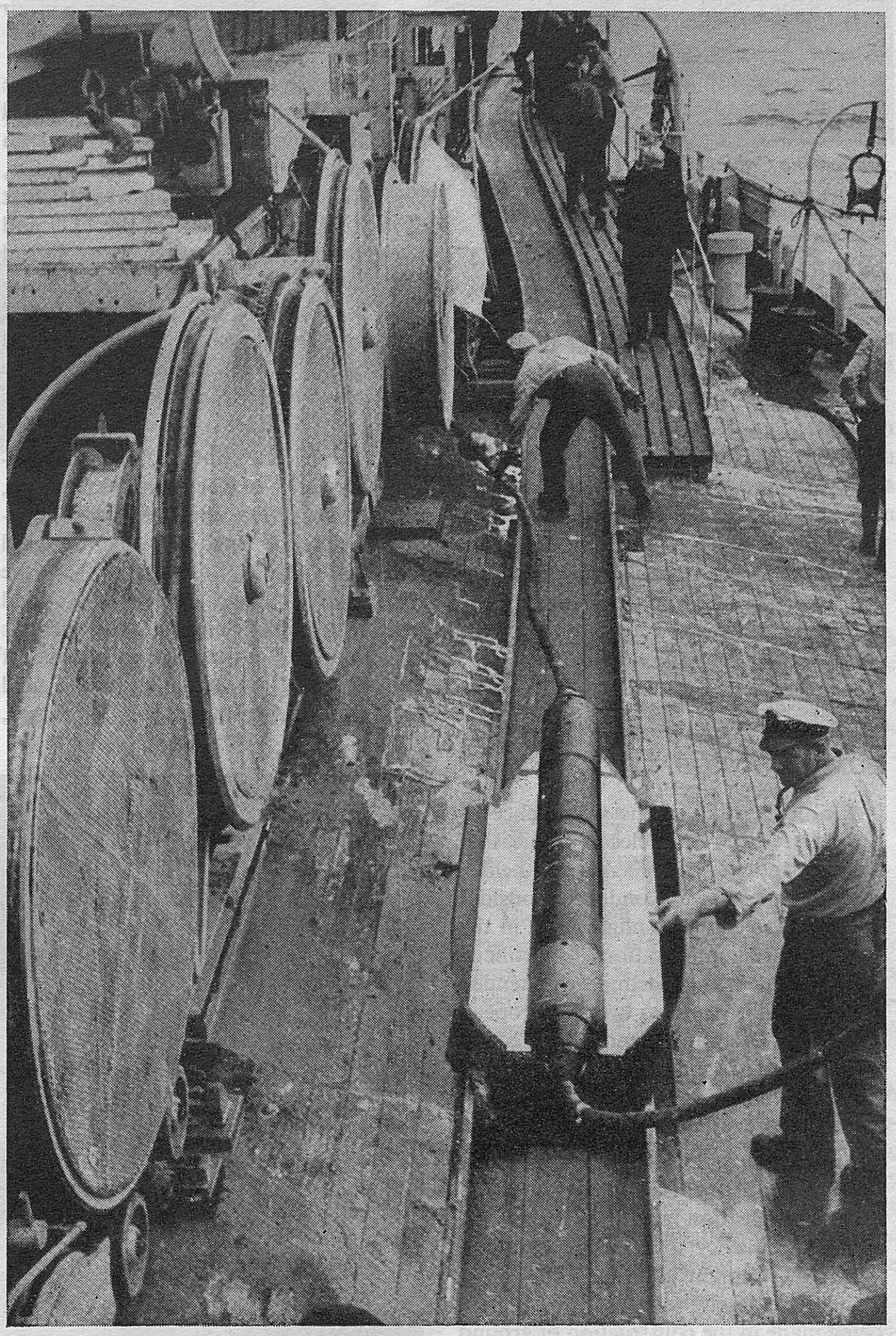
The main deep-sea crossing of *Cantat* is from Oban, Scotland, to Hampden at the head of White Bay on the north coast of the island of Newfoundland. Except for the shore ends, this section, covering 2000 nautical miles, consists of the new unarmoured lightweight coaxial cable designed by the United Kingdom Post Office and manufactured by Submarine Cables, Ltd.

In this cable are inserted 86 submerged repeaters manufactured by Standard Telephones and Cables Ltd, which amplify speech in both directions. Consequently *Cantat* consists of only one cable instead of two as laid for the earlier system. Nevertheless this cable has an ultimate capacity of 80 circuits in comparison with the previous 48.

From Hampden, *Cantat* continues underground across about 70 statute miles of Newfoundland to Corner Brook on the west coast of the island, this section consisting of a screened submarine-type cable with four repeaters in it.

The mainland of Canada, at Grosses Roches, is reached from Corner Brook by a further submarine cable of 400 nautical miles in length. This cable is designed to provide 120 circuits and contains 20 submerged repeaters together with terminal equipments.

The transatlantic circuits are extended from Grosses Roches to the main Canadian Overseas Telecommunication Corporation (COTC) terminal at Montreal over microwave and normal cable systems. Likewise the transatlantic circuits are connected from the Oban terminal to London Over normal telephone landlines.



A submerged repeater about to be launched *(Photo Standard Telephones and Cables, Ltd.)*

As a result of opening *Cantat* the number of public telephone circuits between London and Montreal is nearly doubled, and there are 10 more circuits between London and New York *via* Montreal.

The number of London-Montreal telex circuits is increased from 11 to 20, and it is expected that some circuits direct to Vancouver for traffic connected westwards to New Zealand, Australia and Japan will be made available.

No increase in the number of public telegraph circuits from London to Montreal is necessary at present, but *Cantat* will enable demands for leased telegraph circuits and for high-speed data-transmission circuits to North America to be met. Additionally it will provide telegraph and telephone circuits from Canada to Europe *via* London.—*United Kingdom General Post Office; Submarine Cables, Limited; and Standard Telephones and Cables Limited.*

INTERNATIONAL POLYTECHNIC SYMPOSIUM IN NEW YORK

The Polytechnic Institute of Brooklyn announces that the Twelfth Annual International Polytechnic Symposium will be held in New York City from 24 to 26 April on "The Mathematical Theory of Automata". This Symposium, which is being co-sponsored by the Institute of Radio Engineers and the American Institute of Electrical Engineers, will stress the application of mathematical techniques to information-handling systems. —*Polytechnic Institute of Brooklyn.*

CEPT MEETING ON SATELLITE COMMUNICATIONS

A Study Group of the Conference of European Postal and Telecommunication Administrations (CEPT) recently held a three-day meeting in London to consider various problems that might arise in the field of telecommunications by artificial earth satellites. The meeting was attended by representatives from twelve European countries—Belgium, Denmark, Federal Republic of Germany, France, Ireland, Italy, Netherlands, Norway, Portugal, Sweden, Switzerland, United Kingdom.

Among the points discussed were the possible requirements for intercontinental telecommunication facilities *via* satellites, and the frequency space requirements to which these might give rise. The Study Group also briefly reviewed the progress being made in the construction of ground radio stations in Europe for participation in experimental tests with American communication satellites planned to be launched in 1962.—*United Kingdom General Post Office.*

TOKYO-HAWAII SUBMARINE CABLE

A plan for laying a submarine cable between Tokyo and Hawaii has been decided between the Japan Overseas Telecommunication System (KDD) and the American Telephone and Telegraph Company.

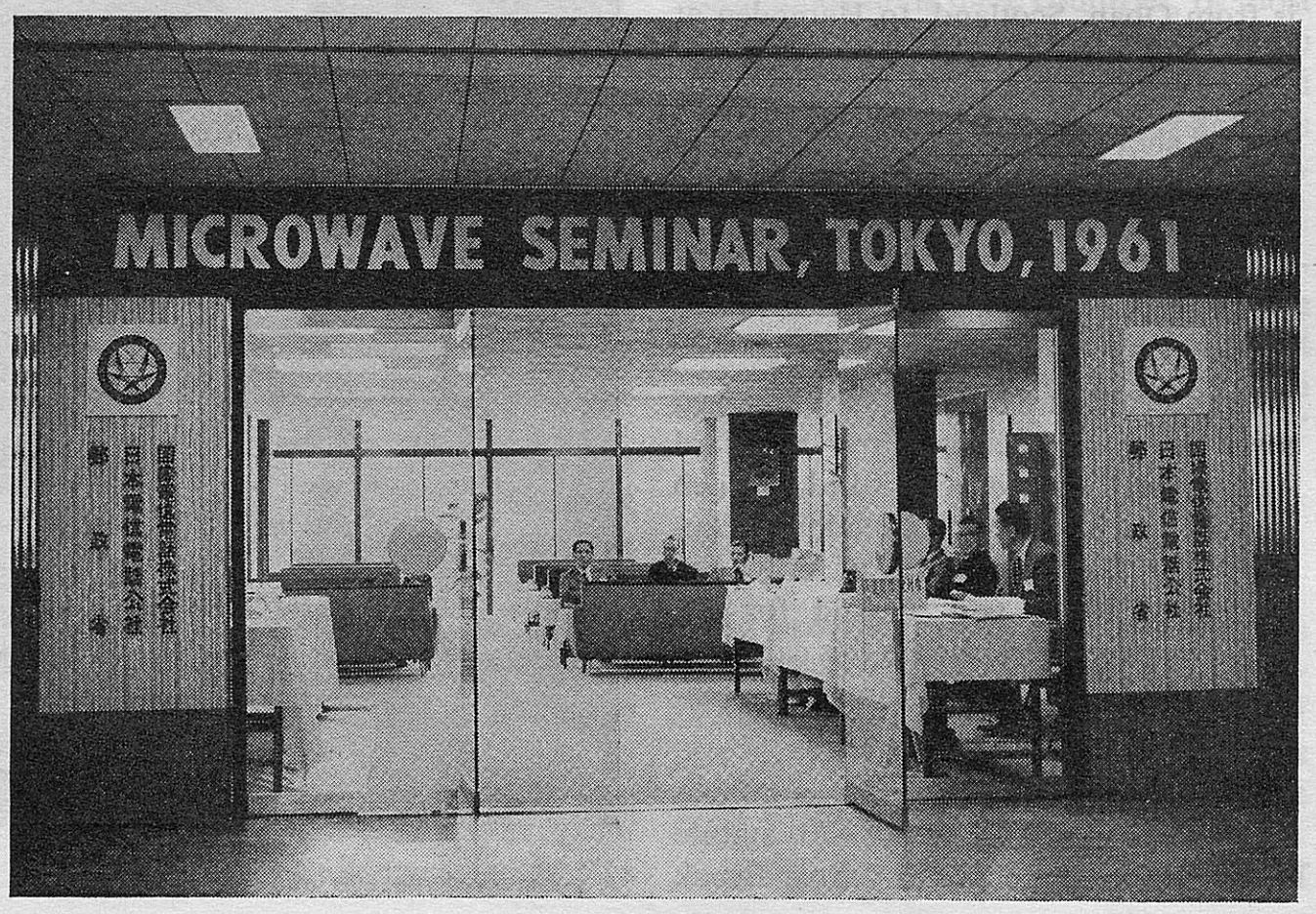
According to the plan, a 10 000 kilometre cable will be laid covering the 5600 nautical miles between Tokyo and Hawaii. Upon its completion, scheduled for June, 1964, 128 telephone circuits will be made available each way. The Tokyo Olympic Games, scheduled to be held in October of the same year, will be televised in the United States through this cable line.—*News from Japan.*

MICROWAVE ENGINEERING SEMINAR IN TOKYO

A report has just reached us on the Seminar on Microwave Engineering and Field Techniques which was held in Tokyo from 30 October to 11 November, 1961. The Seminar, which was the first of its kind in the annals of the ITU and Japan's first contribution to technical assistance in kind, was organized jointly by the Japanese Ministry of Postal Services, the Nippon Telegraph and Telephone Public Corporation and the Kokusai Denshin Denwa K.K. under the auspices of the ITU.

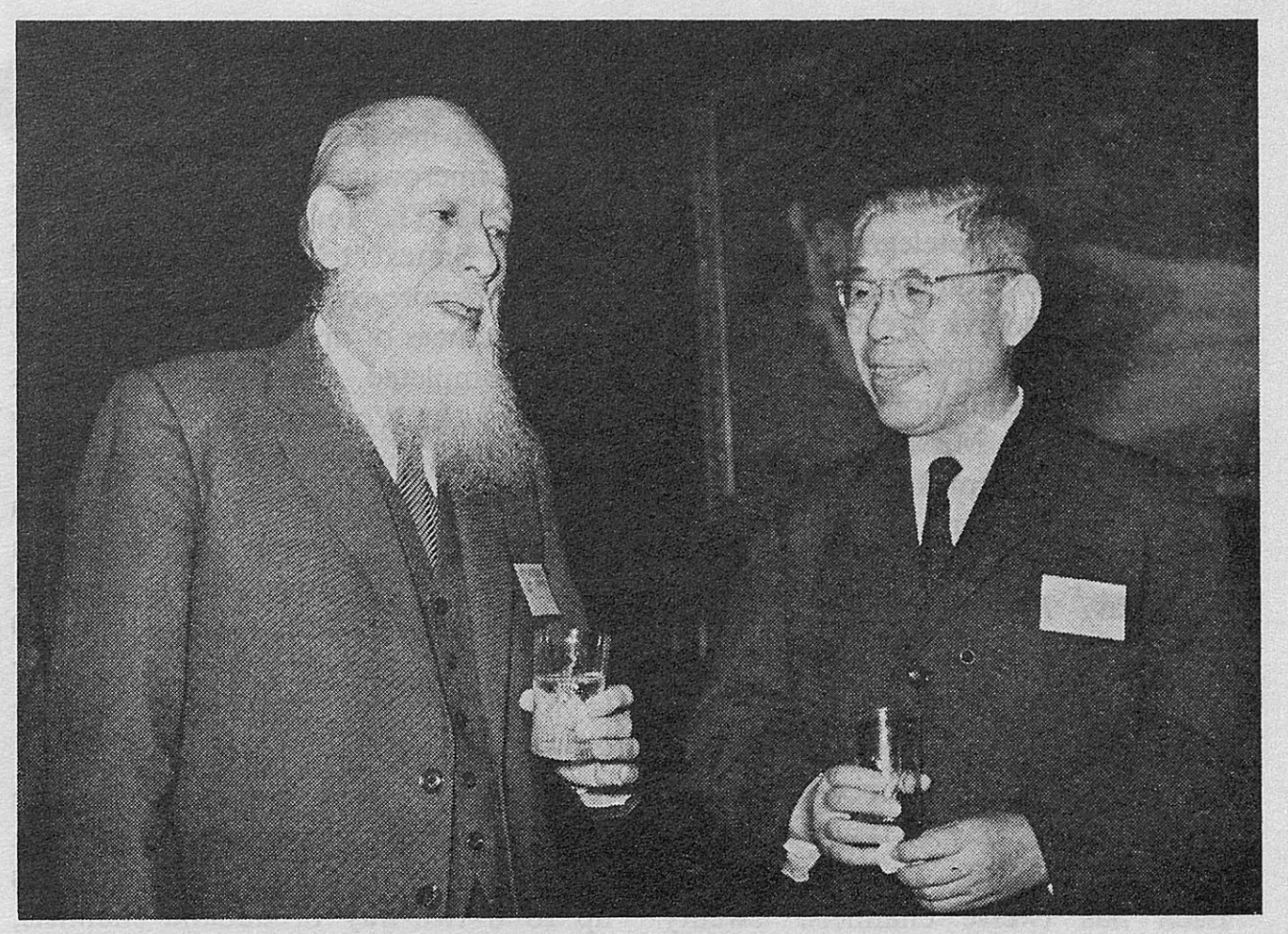
Mr. Hidekazu Matsuda, Administrative Director of Telecommunications, Ministry of Posts and Telecommunications, Japan, opened the Seminar and Dr. Issac Koga, Counsellor of the Kokushai Denshin Denwa K.K. and Chairman of the Seminar, followed this up with a brief outline of the functions of the ITU and its activities in the field of Technical Assistance. His Excellency, Hisatsune Sakomizu, Minister for Posts and Telecommunications, then welcomed the participants on behalf of the Administration of Japan and Mr. V. R. Sundaram, Chief of the Technical Assistance Department of the ITU transmitted the Secretary-General's message to the Seminar. Mr. José Alfonso, Director, Bureau of Telecommunications, Department of Public Works and Communications, Philippines, replied to the Minister's speech on behalf of the participants. The meeting closed with a special lecture by Professor Dr. Hidetsugu Yagi, Member of the Japan Academy of Sciences and Fellow of the Institute of Radio Engineers.

During the ensuing two weeks twelve technical sessions took place, in which 41 technical papers, covering all aspects of Microwave Engineering, were read and discussed. In addition, visits to installations, manufacturing plants, research and



telecommunications laboratories and field trips were conducted. The Seminar closed on Saturday, 11 November, when the achievements of the Seminar were reviewed by its Chairman, Dr. Issac Koga. Short speeches of thanks were made by Nai Pitak Chanchareon (Thailand), Mr. Mohamed Husain (Pakistan), Mr. Katsuzo Ohno (Executive Director, Kokusai Denshin Denwa) and Dr. Hiroji Kurokawa (Nippon Telegraph & Telephone). All agreed that valuable personal contacts had been established between microwave engineers of different countries and that the pooling of their experience constituted a great achievement which would prove of considerable use in the future.

Sixty-nine participants, representing nineteen countries, attended the Seminar. Proceedings of the Seminar (in two volumes) have now been printed and distributed to all Members of the ITU.



Dr. Hidetsuga Yagi and Dr. Issac Koga at the Seminar

administrations and operating companies

FIRE IN AUSTRALIAN TELEPHONE EXCHANGE

Shortly after midnight on Friday, 22 September, 1961, the " Civic " Exchange, Canberra, Australia, housed in a prefabricated aluminium building was destroyed by fire. The total damage exceeded £500 000. The fire completely destroyed equipment which served approximately 5500 telephone exchange lines; more than one third of the Canberra City network. The destruction of an exchange of this size is unprecedented in Australia.

Action to restore service to subscribers was commenced immediately. Urgent services including police, fire, ambulance, medical and public telephone were restored within 24 hours by connection to the Manuka and Barton exchanges. Two pay stations and additional public telephones were provided in the area to assist disconnected subscribers to obtain service. Pending the completion of a permanent relief exchange temporary service to all other subscribers previously connected to Civic was provided within 24 days by the use of 5300 lines of equipment contained in nine portable exchanges transported to Canberra from Sydney, Wollongong, Newcastle, Melbourne and Adelaide. The first of these exchanges arrived within 30 hours of the fire and the last, ten days later. The portable exchanges are normally used to provide temporary service in developing areas pending the erection of permanent buildings and in a number of cases special effort had to be made to change subscribers over to partially completed permanent exchanges so that the portables could be released for the Canberra project.

While the portable exchanges were being installed to provide temporary service, work on the construction of the permanent relief exchange in a new line depot building on the same site as the old exchange was proceeding. Four days after the fire all the 86 equipment racks weighing 60 tons had been erected on levelling plinths and by working around the clock the new exchange was completed and placed in service on 11 November, after which release of the portable exchanges was commenced.

The task of providing emergency service and then restoring all subscribers to their original numbers from a newly installed 7000 line automatic exchange was completed in seven weeks.—*Australian Postmaster-General's Department.*

TELEVISION IN THE SOVIET UNION, 1961

During 1961, more than two million television receivers were produced in the Union of Soviet Socialist Republics.

In 1950, there were two television studios and 1300 hours of television broadcasts. In 1961, there were 57 studios and over a 100 000 hours of television broadcasts.

Two hundred relay stations are operated in the Soviet Union.

Plans are afoot for 11 new television centres, at Astrakhan, Ulan-Ude, Petropavlovsk, Orenburg, Cheboksary, Saransk, Pskov, Kursk, Magnitogorsk, Berezniki, and Ordjonikidze.—*Informations OIRT.*

NEW MARITIME RADIO RULES IN THE UNITED STATES

The United States Federal Communications Commission (FCC) recently announced proposals to amend its maritime radio rules to incorporate requirements of the 1959 Geneva Radio Regulations.

The proposed changes would, with certain exceptions, align the VHF frequencies available for maritime mobile operations with the Regulations. They would also permit the use of single channel VHF installations on shipboard on certain frequencies and regulate survival craft stations.

The FCC has also made final amendments to its maritime rules so as to shift

ship radiotelegraph, and coast and ship radiotelephone stations operating between 2 and 27.5 Mc/s to frequencies conforming as far as possible with the Radio Regulations.

United States radiotelegraph and radiotelephone stations on the high seas and the Great Lakes have already voluntarily moved to new frequencies allocated by the Geneva Regulations. Stations in Alaska and in the Mississippi River area have six months to make the changeover. —*Telecommunications Reports.*

THE FIRST ROUMANIAN TELEVISION RECEIVERS

The Elektronika works in Bucharest have just begun mass production of the first Roumanian television receivers. They are of the VS-43 type and have a 43 centimetre screen.

Each has twelve channels. Twenty thousand television receivers have been produced in Roumania this year.—*Informations OIRT.*

" TL " MICROWAVE SYSTEM IN THE UNITED STATES

The first installation of a new, transistorized microwave radio relay system, known as TL and designed to meet United States telephone companies' needs for more economical transmission over distances of up to 200 miles, is now being completed, according to a recent report by the Western Electric Company and the Bell Telephone Laboratories.

The companies said the TL system provides a radio system competitive in cost with cable and open wire where requirements are as low as 25 to 50 circuits, but its maximum circuit capacity is much greater, allowing for future growth.

The TL system operates in the 11 000 Mc/s frequency area, and requires a relatively small power source. It provides up to 6 two-way broadband channels, each of which could carry 240 simultaneous telephone conversations.—*Industrial Communications.*

NEW RADIO RECEIVER WITH MAGNETIC STORAGE

A new Dual Diversity Sideband Receiver has been produced by Kahn Research Laboratories Inc. for point-to-point multi-channel radiotelephone, radiotelegraph, or facsimile reception. It provides two independent 6 kc/s receiving channels and features an all-electronic, automatic frequency control circuit which reduces tuning errors and transmitter drifts of up to ± 2 kc/s to less than 1 or 2 cycles. It also includes a unique magnetic storage device which insured proper tuning even during severe carrier fade.—*Kahn Research Laboratories.*

HORN RADIATOR

On a 1000-acre site near Rumford, Maine, USA, Bell Telephone Laboratories is installing what is said to be the world's largest horn aerial as part of a new experimental space communications station. The 250-ton steel and aluminium structure will be a rotating aerial—177 ft long, 94 ft high, and will be protected from the weather by an inflated spherical cover, or radome, 210 ft wide, 161 ft high.

The huge horn will rotate on two concentric circular tracks on the ground. It will also " roll " about its horizontal axis so that it can follow a satellite from low to high angles of elevation.

The radome will be supported by air pressure of one tenth of a pound per square inch greater than the outside atmospheric pressure. It will be anchored to the top of a 14-foot wall that will encircle the base of the aerial. Double doors provide an " air lock " to avoid losing pressure.—*Wireless World.*

technical

NEW AUTOMATIC DATA EXCHANGE SYSTEM

A super-speed system capable of handling a million bits of electronic information per second in directing message and data communications of widespread organizations has been designed by International Telephone and Telegraph Corporation (ITT).

The ADX System is a fully-automatic, solid-state, stored-programme, record-communications switching centre. It is capable of receiving, analyzing, processing, storing, rerouting, and transmitting messages and data of varying speeds, codes, and formats to and from hundreds of points—yet requires as little as 1/10th the power and space normally needed.

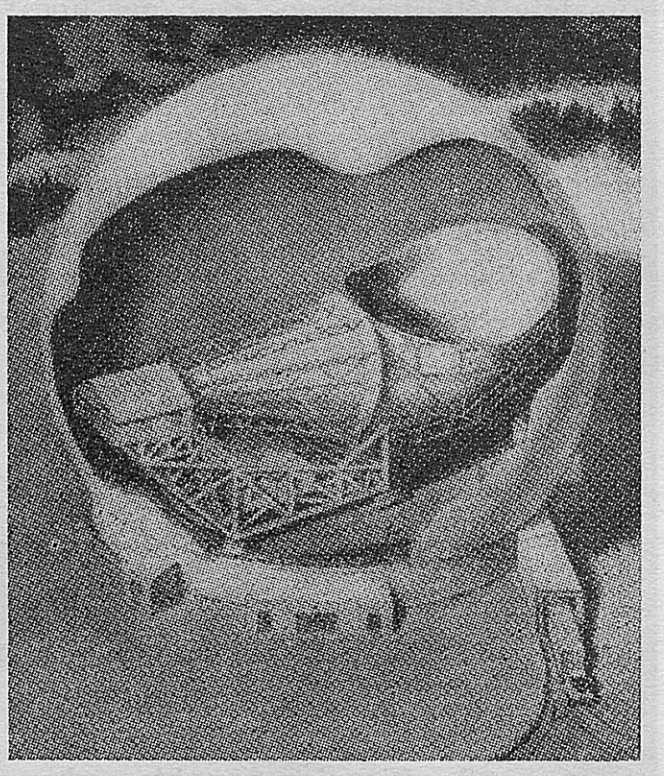
As it directs routine message traffic, the ADX System also performs a traffic control function. When an urgent message arrives at the centre, the system instantly and automatically side-tracks lower-priority traffic in its path and routes the more important communication immediately to its destination. When this occurs, or when lines are momentarily operating at capacity, the lower-priority messages are temporarily stored by electronic devices called " magnetic cores " and " magnetic discs." Each of these delayed messages can be retrieved for retransmission in fractions of a second. Permanent records of all communications can be stored on reels of magnetic tape.

Another feature of the ADX System is its ability to route a single message to several designated points simultaneously or according to priority as individual lines become available, or even in terms of local times at various locations around the world. Thus, no message is delayed because the lines of all addresses are not clear.—*ITT.*

WIRELESS WAVES TO FREEZE FISH

Pye and Company (United Kingdom of Great Britain and Northern Ireland) have devised a new means of speedily freezing fish, making use of radio waves.

Fifteen minutes is all that is required to accomplish what took twenty-four hours by circulation of hot water or air.—Radio Constructeur et Dépanneur.



Cut-away drawing of the Bell horn radiator inside its radome. Eventually five such structures may be built on the Rumford side. *(Photo: Wireless World)*

SPACE COMMUNICATIONS of the NEXT GENERATION

by

ANDREW G. HALEY

Presented at the Space Law and Sociology Session of the American Rocket Society Space Flight Report to the Nation—New York Coliseum—October 10, 1961

★

DURING THE NEXT GENERATION the achievements of science in the field of communications technology will surpass by a multiple factor all of man's past achievements in this field, including remarkable inventions characterizing what we now call telegraphy, telephony, radio disseminations of all kinds, and even television and picture technology in general. The bright vistas of technical progress are indeed heartening.

The dark and somber prospect of sociological and legal progress on the face of the earth and on any planet which may be inhabited by mankind is indeed disheartening because the very purpose of communications is now completely frustrated by national self interest, and the ability to receive communications is highly attenuated by language barriers and by the customs of " tribes."

This paper is fundamentally concerned with the immense sociological and legal problems which confront mankind, but the prospects for technical achievements which may be envisioned in nature must first, in a most general manner, be understood. We must illuminate the enormous proportions of the crisis which faces man on earth and in his exploration of space.

Three stages

By way of analogy, let us consider the development of air and space travel.

During the first stage the propeller airplane was developed, using what is basically the thrust developed by a screw in an ocean of air in the same manner that a blade propels a ship in an ocean of water. This stage, let us assume, ended with the " turboprop " airplane.

The second stage may be roughly described as the age of the " pure jet." Now we find the screw abandoned and transportation is freed from the shackles of the surface wheel and a highly inefficient type of engine. Thrust is directly derived from the atmosphere in a " not so highly complicated " thermodynamic system. Enormous savings in engineering gear on the one hand, and in travelling time on the other hand, are achieved.

And so we come to the third stage, the age of the rocket powerplant which unshackles man from both the wheel and the atmosphere and enables him to traverse the universe. The types and kinds of motors are so many in number and so varied that it would be quite inappropriate to discuss or even to outline on the roughest basis the alpha to omega of solid rockets to radiation propulsion devices.

We proceed with our analogy to communications. In the first analogy we did not discuss the oxen and the dragharrow or the horse and buggy but we proceeded immediately to the aircraft. A peculiar and rather frustrating exception must be made, however, for primitive means of communicating by light signals because we will find later on that light signalling will again become one of the most significant means of communications.

And so we will simply characterize the first stage as the stage of electrical communications which resulted in the epochal advent of the telegraph and telephone.

The second stage is the " radio age,"—the age of wireless, in which the radio spectrum is utilized for all forms of communications—telegraphy, telephony, television, and so on. Radio has enabled man to communicate by signalling, by voice and by the transmission and reception of pictures throughout the world and, to a significant extent, throughout the solar system, even to the making, sending and reception of pictures on the far side of the moon, and to signalling the moon, Venus, and probably other objects in outer space. The most disheartening aspect of the radio age is not the great abundance of inventions and possibilities of use, but the limitations on the spectrum itself.

And so we come to the third stage in communications —a stage in which nature exposes to man possibilities so diffuse and useful as to defy description and challenge the imagination.

Just as a surveyor with his transit, looks back in the process of determining the road ahead, it is profoundly interesting to note that even in the course of a year, technology in communications theory and invention has been indeed significant.

Research

In a report to the United Nations in 1960,* Professor Pierre Auger stated that telecommunication research is based on extensive studies in the fields of physics, chemistry, metallurgy and mathematics. He listed as subjects worthy of study, the physical properties of solids, and new methods of determining the purity of substances by physical and chemical analysis which offer extensive prospects for research on the functioning of hot cathodes; junctions in semi-conductors and the emission of recombination light; cascade phenomena, which are extremely important in the study of electron emission by semiconductors; the physical phenomenon of electro-luminescence and the intermediate energy levels which may exist in it (using the substances involved, it will also be possible to initiate research on photo-voltaic, photo-resistive, photo-piezo-electric and other effects); the physical phenomena underlying parametric amplification; such substances as the rare earth ferrites; the theorems governing the electro-magnetic operation of both active and passive multipolar electricity networks (filters, equalizers, etc.) in all frequency ranges; the optimum coding of signals and the elimination of redundancies.

In 1961, we find the prophesy of 1960 well implemented. The scientists actually are ahead of schedule !

In the radio frequency spectrum, saturation conditions are encountered in most bands. As an example of the extent of present-day use of the radio spectrum, in the United States there are more than 2.5 million radio transmitters in the safety and special services categories alone. These categories do not include broadcasting stations, common carrier systems, or the vast military and governmental radio systems. New techniques such as single side-band transmissions have made possible additional radio assignments, but if anything, our constantly expanding use of the available radio frequencies is outpacing the development of new devices designed for frequency conservation and sharing.[1]

New techniques

The " third stage " involves fundamental departures from the present-day use of radio frequencies. A popular example is " Coherent Lights," in which message-bearing light waves are employed. This technique, while today in an elementary state of development, has been employed experimentally and focused and disciplined so that it moves in phase as radio waves do. A far greater system capacity is inherent in the " Coherent Lights " concept than is possible within the confines of the radio spectrum. Estimates have been published stating that through the use of " Coherent Lights " the number of

* See page 57.

[1] " More, Faster Communications," *Business Week*, 25 February 1961.

communication paths will exceed by a factor of 10 000 times those made available in the radio spectrum.[2]

The availability of new communications systems with vast capacity is of vital importance to the development of space communications during the next twenty-five years. At the 1959 Administrative Radio Conference in Geneva, for example, we were able to secure a total of only slightly more than 130 megacycles of the entire radio spectrum between 10 Mc/s and 10 000 Mc/s for use in space.[3] Even this small portion of the spectrum was restricted to " space research " functions, and the entire question of providing adequate space for operational use (communications, mass disseminations, guidance, command, data transmission, navigation, and so on) was postponed until late in 1963. It is to be hoped that a world conference will be held on the subject late in 1963. Through a worldwide Study Group of the International Radio Consultative Committee (CCIR) we are currently attempting to " fit in " vast new demands for spectrum space, to coordinate all space radio allocations with the existing terrestrial allocations, and to arrive at recommendations for the proposed 1963 Conference. The task is one of the most staggering assignments which has faced the CCIR and the International Telecommunication Union.

We cannot wholly discard the radio spectrum as the principal medium for the development of space communications during the next generation. Too much research and development have gone into our present and proposed space systems, and too much " hardware " has been developed on the basis of radio communication capabilities even to consider such a wholesale change. Nevertheless, we must look to the areas of " Coherent Lights," maser and laser technologies, gamma ray transmissions, and other scientific breakthroughs, for relief from the stifling effects of the crowding and other inadequacies which characterize the present radio spectrum.

Space Roundtable

At the Space Communications Roundtable held during the XIIth International Astronautical Congress, unique communication possibilities utilizing " unconventional techniques " were discussed by a panel consisting of Dr. Eberhardt Rechtin of the Jet Propulsion Laboratory (Chairman), Dr. George F. Smith of Hughes Research Laboratories, Mr. J. W. Ogland of Westinghouse Electric Corporation, Dr. Jozef W. Eerkens of Aerospace Corporation, Dr. J. P. C. Leiphart of the US Naval Research Laboratory, Dr. J. P. Gordon of Bell Telephone Laboratories, and Dr. Huber Heffner of Stanford University. These techniques promise the " breakthrough " in space communications technology which we now seek. At this stage, they are purely experimental. But enough is known today to justify accelerated development and perfection of the systems.

Dr. Rechtin set the theme of the Roundtable by stating that

> " At the present time and with available techniques, conventional radio communications in the frequency band of 20 Mc/s to 20 Gc/s is satisfactory for efficient space communications within the solar system. The purpose of the roundtable is to discuss possible communications techniques outside of the conventional communications band." [4]

The Roundtable participants directed their attention to three principal systems of space communications which do not involve the use of the radio frequency spectrum. Drs. Smith and Gordon discussed the use of light frequencies for radar and communication purposes. Basically the use of light frequency systems involves maser and laser technology and forms of optical equipment. Mr. Ogland reported on the use of ultraviolet radiation. He reported on the status of presently successful techniques in power generation and the vast ranges which are possible for communication using the ultraviolet system. Dr. Eerkens considered the unique communication possible in atmosphere-free space by means of gamma radiation emanating from nuclear reactors used in propelling space craft.

1. THE USE OF LIGHT FREQUENCIES

Dr. Smith discussed types of communications and radar tasks that appear to be reasonable in the next →

[2] " Coherent Lights Seen Outperforming Radio," *The Washington Star*, 5 June 1961.

[3] Radio Regulations, Geneva, 1959.

[4] Abstract, Space Communications Roundtable, by Eberhardt Rechtin, XIIth International Astronautical Congress, Washington, D.C., 1961.

decade or two using lasers and other optical equipment. The exact methods whereby such laser systems can be implemented are " not easy to specify at this time partly because there are still some big unknowns in the area of modulation and receiving techniques." It is possible, however, according to the Roundtable participants to make probably meaningful order of magnitude calculations as to bandwidths which will be available at interplanetary distances.[5]

The laser was developed approximately one year ago by Hughes Aircraft Company and Bell Telephone Laboratories, and other firms have contributed significantly to the field. " Laser " is an acronym derived from " light amplification by stimulated emission of radiation." Basically, a laser produces strong oscillations by focusing radiation. Intense light is one product of the device, and potential uses include optical radar and the destruction of selected living cells for surgery.[6]

Lasers and masers

At this point it is essential to differentiate between laser and maser technology and to comprehend the functions and capabilities of each system. Basically, masers perform the same function with respect to signals generated on very high radio frequencies as lasers do to light radiations, namely, they focus and intensify radiation and set up strong oscillations. Maser amplifiers and oscillators convert the internal energy of a molecular system into microwave energy by the interaction of electromagnetic radiation directly with the molecular system.[7] Thus, the form of energy produced by maser action is an electromagnetic signal in the microwave frequencies region. Energy emanating from laser action, on the other hand, is in the form of emission of electromagnetic energy on frequencies in the range of light.

In the laser transmitter a suitable active material (solid, liquid or gas) is placed between two parallel mirrors and excited from a special light source called a " pump " which usually surrounds the active material. Energy from the pumping light excites atoms in the active material, causing them to emit light which is reflected back and forth between the two mirrors. A process of further light stimulation produces significantly greater intensity and ultimately an extremely narrow beam of great intensity is projected.

The unusual characteristics of the laser make it extremely useful for space vehicle navigation, according to the authors of a report prepared by General Precision, Inc., and presented at the 1961 Institute of Navigation. A highly accurate radar capability is enhanced in this system, and it is estimated that an error of not more than one mile would be encountered when two vehicles are 100 thousand miles apart. Furthermore, an extremely small power input would be required. In comparison with conventional radar systems using radio frequencies, the laser enjoys substantial advantages. The accuracy of velocity measurements is greater for the laser system. In the target acquisition phase the position of a very small object may be determined through automatic scanning of a great volume of space. Where scanning is not required, the power advantage of the laser system enhances its value greatly in comparison with the conventional radar system.[8]

Technical advantages

During the Space Communication Roundtable Dr. Smith pointed out that in the past, communications at optical frequencies have been severely restricted by the low intensities of available incoherent light sources with black body temperatures limited to a few ten thousand degrees kelvin. The laser, as a coherent light generator, provides some six orders of magnitude improvement in spectral brightness and makes possible optical communications at interplanetary, and perhaps at interstellar distances. The coherent radiation from a laser can be focused into an extremely narrow beam with optics of modest size. This permits efficient transmission to large distances. Since the light is monochromatic, filters can be used to discriminate against sunlight or starlight.

In principle, Dr. Smith stated, it is possible to modulate a laser beam with a microwave signal, giving a very large channel capacity. New techniques for modulation and coherent detection will be required, and are being developed. He adds that the intense narrow beam from

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[5] *Op. cit. supra*, note *4*.

[6] *Op. cit. supra*note 2.

[7] *Electronics and Nuclear Engineering*, Sarbacher, Prentice-Hall, Inc., 1959.

[8] " Laser Challenges Radar for Space Use ", *Aviation Week*, 24 July, 1961.

a laser can be used for optical ranging in a *Colidar* (coherent light detection and ranging) system. In rudimentary experiments with a ruby laser, it has been possible to achieve seven-mile ranges in broad daylight. Fifteen to twenty-mile ranges are available at night. It should be possible, therefore, to detect the surface of the moon with an improved ranging system using current laser and optical technology.

From considerations of diffraction limitations and shot noise effects, Dr. Smith states, it is shown that the channel capacity of a given one-way communication system is theoretically proportional to frequency. At optical frequencies, however, the diffraction-limited beams involved become too narrow for reliable aiming. In terms of practical limitations, the overall channel capacity is inversely proportional to the operating frequency, the square of the distance and the square of the transmitting antenna beamwidth. When fairly conservative numbers are used, this relation predicts bandwidth of only 8 kc/s for a one-way Mars-to-Earth laser system. However, Dr. Smith adds that Dr. C. H. Townes has suggested more optimistic assumptions which give 10^8 kc/s (overall bandwidth). The Townes' system would be visible to the naked eye at one-tenth light year and detectable at several tens of light years.[9]

Overtone experiment

The laser in its present state of development is severely limited. It may be possible to develop some substitute for conventional sound transmission by recording, or some other form of breakdown of components. In this respect, only a few months ago the first overtone of a beam of light was produced by physicists of the University of Michigan. The laser's intense beam of pure red light was focused into a quartz crystal. The second harmonic —a deep blue beam—was produced as a result of the extremely high intensity of the red light at this focus. The laser light has a focused intensity one billion times greater than sunlight on the earth's surface, and this intensity produces blue light from the red in much the same way that overtones are produced in music. The physicists who observed the phenomenon analogized it to the strumming of a guitar which produces certain musical sounds, and the vigorous "twanging" of the instrument which produces more intense overtones.[10]

The principal implication of the successful overtone experiment in laser technology is that it may open the way for the practical use of electromagnetic waves in the frequency region of light for communication purposes. A second potential field of development relates to the investigation of the properties of materials which have been beyond study in the past, e. g., the non-linear optical properties of various materials.

Minneapolis-Honeywell Company has developed a communication system which uses what it terms "ray guns" to transmit voices secretly and silently. The system consists of sending and receiving units each shaped like guns. The devices are aimed at each other and a narrow beam of infrared radiation is transmitted. Words spoken into the device are converted by electronic means into infrared and transmitted between the sending and receiving units and converted back into sound. This device has an extremely limited range of some twenty miles which makes it of no practical significance for space communications.[11] Development and improvement of the system and adaptation to the laser technique, however, may well provide a highly valuable and useful device for space communications.

2. THE ULTRAVIOLET TECHNIQUE

Mr. Ogland has discussed the development of basic techniques for a space communications system operating in the ultraviolet spectrum. In an earlier paper[12] Dr. Ogland took the position that extension of range and provision for information security are of paramount importance in space communications systems. Long ranges require large antenna gains and low noise level. These requirements are best met by the use of optical wavelengths. Of these, the ultraviolet spectrum provides the best freedom from noise. To obtain narrow beamwidth with non-coherent radiation, extremely high power density must be generated in a small spot. This is best →

[9] Communication to the Author from Dr. George F. Smith, 8 October, 1961.

[10] News Release, University of Michigan News Service, Physics Department, 11 August 1961, made available by Science Service, Washington, D. C.

[11] Science Service, Washington, D. C., data taken from office files.

[12] "Ultracom, Ultraviolet Communication System," by J. W. Ogland, 1960.

obtained by exciting a suitable phosphor with a high voltage electron beam. Such a device is also easily modulated up to several megacycles. In experimental equipment, a power density several times that on the surface of the sun has been produced. One watt power thus suffices for ranges nearly 50 million miles at bandwidth 10 c/s and S/N-10 and antenna gain 77 db. Alternatively video information may be transmitted over correspondingly shorter ranges with the same power. By optimized design an increase of the power density by more than an order of magnitude appears reasonable.

Security and power consumption

Dr. Ogland pointed out in that paper that rapidly advancing space technology of today, with space vehicles being developed for missions to tremendous distances, demands an efficient means of communicating with maximum security and minimum power consumption. When communicating in space, no absorption, reflection or scattering occurs. The main factors determining range, then, are antenna gain and receiver noise. It is well known that with given dimensions the highest antenna gain is obtained with the shortest wave lengths. Optical frequencies, therefore, will give the narrowest beams and highest antenna gains. Infrared would suffice with regard to optical beaming ability, if it could be produced in a point source of sufficiently high power density. But no such source is known which can compete with sources emitting shorter wave lengths. Furthermore, noise considerations favour the shorter wave lengths especially the ultraviolet, Dr. Ogland declared. All the planets and other cold objects in space have a temperature high enough for generating noise in the infrared spectrum, but their temperature is not high enough for generating ultraviolet. Probably the most important source of noise is the earth because of its size and proximity to the receiver. Since the earth's atmosphere absorbs ultraviolet, the earth looks dark to an ultraviolet sensor. The sun radiates in ultraviolet and thus constitutes a large source of noise. But it also radiates on all the other wavelengths including radio. Any high sensitivity receiver, therefore, will be noisy or blanketed if its antenna covers the sun. An optical receiver, because of its narrower beamwidth, can better avoid this situation. The noise of most importance in an ultraviolet sensor is the shot noise, which Dr. Ogland discussed in connection with range derivation.

Westinghouse Electric Corporation has conducted tests on an ultraviolet communications system which could provided narrow band communication over distances up to 20 million miles. At such ranges a radiated power of one watt is employed and there is a power consumption of only a few watts. According to Westinghouse, in order to achieve the same ranges using radio frequencies, the radiated power would have to be 100 times greater, possibly more.

The ultraviolet communications system appears to be restricted to use between positions or objects in space, since terrestrial communications would be prohibited because of absorption and attenuation of ultraviolet radiation in the earth's ozone layer and atmosphere.

Advantages

The Westinghouse ultraviolet communications system (Ultracom) employs a small and extremely intense spot-source of narrow band ultraviolet radiation which can be amplitude-modulated easily. The generator consists of a cathode ray tube coated with phosphor that produces ultraviolet radiation when excited by an electron beam.[13]

It was pointed out that the ultraviolet region of the electro-magnetic spectrum offers frequencies at least one million times as great as those in the radio band normally used for space communications. Furthermore, far less power and much smaller antennas and receivers are required than at radio frequencies. The significance of these factors in space vehicle design is obvious.

The ultraviolet transmission system offers another vital advantage, communication privacy, as well as a degree of security from man-made and natural interference.

In 1960, Westinghouse demonstrated an experimental ultraviolet communications system by which both television and voice were transmitted over a short distance. Amplitude modulation was achieved by varying the intensity of the electron beam.

At the Space Communications Roundtable, Mr. Ogland showed that using non-coherent radiation, the range for

[13] " Ultraviolet Tested for Communications," *Aviation Week*, 19 December, 1960.

one watt of transmitted power at narrow bandwidth modulation has been extended to millions of miles. These long ranges are attained by concentrating the radiation in a beam as narrow as two minutes of arc, which gives an antenna gain of about 77 db. The evident problems are to build point emitters of sufficiently high power density and to design detectors who will be sensitive to a limited number of quanta. Mr. Ogland discussed some of the presently successful techniques in power generation, and derived a range equation similar to that of radio communication which shows the ranges possible for various parameters of values.[14]

3. *THE GAMMA RAY TECHNIQUE*

An investigation was made by Dr. Eerkens as to the use of reactor gammas for communications in space. Dr. Eerkens pointed out that nuclear power reactors employed in future space systems will produce large quantities of gammas as a by-product. Gamma beam modulation methods were observed in the course of Dr. Eerkens' investigation, and it was determined that this phenomenon is limited to communication in outer space since the gammas are heavily scattered and absorbed in the atmosphere. Gamma radiation, therefore, would be dissipated or absorbed before receipt at an earth station.

Dr. Eerkens pointed out the advantages of the gamma communication system, particularly the relief of demands on the radio frequency spectrum, which may be obtained by the use of the new gamma frequency regime. Furthermore, the gamma ray communications system permits the use of smaller antenna components and produces better focus and resolution at the higher frequencies.

The gamma ray communications system converts what was heretofore regarded as a " nuisance," namely, the production of gamma ray in a nuclear reactor, into an asset of substantial value in a space exploration programme. Dr. Eerkens states, " whereas the generation of microwaves or radio waves would require a special electric power source and wave generating equipment, the source of gammas is ' for free '." [15]

Dr. Eerkens has proceeded beyond the study of transmission method to a consideration of methods of carrying information on the gamma beam. He reports that a chopper placed in front of the conical opening, consisting of a rotating disc with equally spaced holes in it, could impart the required information on the gamma beam by modulation of the rotational speed of the disc. Other mechanical methods such as vibrators are also envisioned for the production of information to be transmitted by the gamma beam.

Dr. Eerkens' computations indicate that low quality voice would be transmitted approximately 48 miles by a typical moon-based power plant. With an optimized overall design, a 10- to 100-fold improvement in range is possible. Dr. Eerkens estimates that code could be transmitted 8000 miles under assumptions which are required at this time, and there is a potential improvement to an 80 000 to 800 000 mile maximum range.

Comments

Since the Space Communications Roundtable, Dr. Huber Heffner of Stanford University, has had occasion to review the proceedings and to comment thereon at the request of the author. Dr. Heffner's remarks [16] are summarized as follows :

The papers of the IAF Communications Roundtabel session have largely been related to the question of optimum frequency for a communications system operating across vast distances. The answer to this question involves our capability in building a transmitter and its associated modulator, our knowledge of the transmission medium, its absorption and noise characteristics, and our capability of constructing a sensitive receiver. Except in the radio frequency range, our knowledge of all these factors is so slight and our rate of progress so great that it makes little sense to attempt at this time to predict the future course of space communications.

The basic problem which underlies all of these system considerations, according to Dr. Heffner, is that of transmission of information. Before any choice of optimum frequency can be made, we need a theory of communications which is valid at optical and higher frequencies. Sheer bandwidth available does not necessarily imply greater channel capacity if we are forced to take quantum →

[14] *Op. cit. supra*, note 4.

[15] " Gamma Ray Communications,"Abstract, Space Communications Roundtable, by Dr. Jozef W. Eerkens, XIIth International Astronautical Congress, Washington, D. C., 1961.

[16] Communication to the Author from Dr. Huber Heffner, 8 October, 1961.

effect into account. For the first time, engineers are faced with the vast particles duality which has plagued physicists for years. We now desperately need a quantum theory of communications. Some steps have been made in this direction and there is some evidence that a low frequency quantum in some sense carries more information than one at high frequencies. If this is so, it will have a profound effect on our choice of frequency.

Regardless of the solution to this problem, Dr. Heffner continues, there are a few things which we can say concerning the cost of communicating at optical frequencies or beyond. For example, it can be very generally shown that the best phase sensitive detector requires at least one photon per resolution time (reciprocal of the bandwidth) to equal the unavoidable quantum noise generated. Thus, since the high frequency photon is more energetic, more power must be received at the detector for a given bandwidth if the carrier frequency is raised. Dr. Smith has shown that one can more than buy back this power cost by the increased gain of given system antennas as frequency increases, but only at the expense of increased aiming difficulties. If it turns out that the channel capacity also varies with frequency, these conclusions may have to be modified.

According to Dr. Heffner, this narrow beam width which goes along with high antenna gains limits the usefulness of the optical radar mentioned by Dr. Smith. Such a radar would certainly be impractical for search purposes, since the time required to scan an appreciable solid angle would be huge, Dr. Heffner concludes.

Other systems

Dr. Heffner states that he is not as pessimistic as others seem to be regarding the efficiency of the optical maser. There are one or two schemes for d. c. current pumping of optical masers which may provide high efficiency. One of these, still speculative, would involve the doping of an appropriate semiconductor and the excitation of optical levels by injected electrons. This and other schemes might provide efficiencies as high as those now obtained in microwave generators. As an aside, Dr. Heffner notes that it is a curious fact that we are now able to generate kilowatts of optical power while we struggle greatly to generate one watt at a wavelength of one millimeter.

Regarding the ultraviolet system discussed at the Roundtable, Dr. Heffner comments that Mr. Ogland had discussed a communication system at ultraviolet frequency which uses incoherent radius. Dr. Heffner adds here only amplitude modulation can be employed and none of the advantages taken of phase discrimination which are possible in a coherent system. Of course we do not now have a coherent source in the ultraviolet, but this is a fast-moving field and we might well anticipate the existence of coherent sources not only in the ultraviolet but also in the infrared in the next few years.

Dr. Eerkens has described another incoherent system using gamma rays, and Dr. Heffner made the following additional remarks with respect to this phenomenon. Dr. Eerkens has implied that in a space vehicle the system would be free in the sense that the cost of the source, the reactor, could be charged to other budgets. Such a consideration may be misleading, Dr. Heffner contends, since the mass of a suitable modulating system might be inordinately great and mass is perhaps most costly of all. Moreover, Dr. Heffner believes that Dr. Eerkens is incorrect in asserting his system is jam-proof.

Dr. Heffner concluded with respect to the overall merits of the proposals made at the Space Communication Roundtable that " a session of this sort five years from now might provide answers to the questions which at the moment we can only raise."

Human barriers

From our present plateau of civilization there certainly is no clear or hopeful vista of man's utilization of these most promising technical developments in communications. In the first place, on earth there exists an almost hopeless " jungle " of languages. The customs of the " tribe " and the idols of the " tribe " tenaciously and almost fiercely grip segments of peoples and these customs and idols operate as extreme forces of divergence among peoples. On the one hand, there is no clear prospect of eliminating language barriers or tribal divergences from man's adventure in outer space and, on the other hand, there is no clear indication of solutions on earth.

There are, of course, some tiny " glimmerings " of enlightenment, such as uniform navigational codes and

languages, the small progress of " universal languages " and, of course, automatic language translation systems, and so on.

During the course of the next generation communications from outer space and, especially, communications involving the mass dissemination of news and cultural and informational programmes will undoubtedly be tied down to relay transmission and reception only for redissemination on earth by the respective governments on earth and one may expect the same fate to await tribal groups which have been located on objects in outer space. This sorry situation is due to the bleak and devastating conflicts among the nations and tribes of earth. There seems to be constant necessity to " slant " the news and even to censor most cultural and informational programmes.

There is really no technical reason to prevent *direct* reception of transmissions from point-to-point on earth through the means of space satellites, or from transmitting points in outer space to earth, or from earth to points in outer space. Eventually, in the case of mass disseminations direct reception must be permitted. This evolution may well take hundreds and maybe thousands of years.

Life on other planets

In my paper, *Metalaw—The Science of Universal Jurisprudence*, given at the XIIth International Astronautical Congress, the possibility of sentient creatures on other planets was discussed. It was concluded that " an excellent statistical case has been made by Harlow Shapley and many other great scientists for the existence of life on other planets. In connection with these views a further consideration asserts itself and that is the influence of the universal sphericity of planets on the process of evolution. In examining our own world we find that the fact that man has lived on a confined surface has resulted in a concentration of ' contacts.' His psychosocial relationship commenced to form at the moment of his emergence as *homo sapiens* and day by day during the course of the progress of civilization this confined surface has inexorably brought man closer and closer together, and now the very geography of his ' prison ' has caused man to create artifacts which enable him to meet and merge and enhance his psychosocial nature on every part of the globe. Thus man emerges as a highly specialized psychosocial creature due to the confining sphere on which he was evolved."

Undoubtedly, the greatest " artifact " is the communications system which provides a means of massive dissemination of all manner of news, informational and cultural programmes to the most remote points on earth. Over the generations this artifact is bound to break down the barriers of the " tribe " and of nationalism.

The ITU's task

In the meantime, a world agency must be set up to hasten the process of human convergence. The community of nations fortunately created the International Telecommunication Union in 1865 and this oldest-of-all governmental international organizations is ideally equipped to undertake the task of convergence. The first step is to make the ITU a more operational agency which would initially coordinate and police point-to-point and mass communications relayed by earth orbiting satellites and direct communications from the Moon, Mars, and other natural objects in outer space. In so doing the ITU would act as a kind of world communications commission to enforce order among the nations of the earth and pursuant to the individual laws of such nations.

The next step will be for the ITU gradually to evolve a uniform set of regulations for all nations of the earth and to enforce these regulations. The completion of this task may take several generations and hundreds of years of time.

Finally, of course, national restrictions must be abrogated and the ITU will emerge as an untrammeled world agency not only acting as a servant of the peoples of the earth but also of the human dwellers in outer space.

In a recent lecture, Sir Gerald Beadle, former head of the television network of the British Broadcasting Corporation, expressed his agreement with President Kennedy that providing a mass means of dissemination of intelligence is a most critical objective of civilization. Indeed, this paper may well be concluded with Sir Gerald's very language in which he envisions global network capable of breaking " through the language barrier and giving us all something of that sense of world citizenship, without which the human race is surely doomed."

End

telepersonality

14 — SIR EDWARD APPLETON

In 1947 SIR EDWARD APPLETON WON the Nobel Prize for Physics. There is something about the Nobel Prize which sets its winners in a class apart from other men. Among those who have been singled out to join this international intellectocracy, few can have more richly deserved the honour than Sir Edward.

It was in 1924 that Dr. Appleton, as he then was, began the famous series of experiments which proved the existence of that layer in the upper atmosphere now called the ionosphere, thus for the first time successfully employing radiolocation for detection (the basis of course of radar). In 1926 he discovered the " Appleton Layer " some 240 kilometres from the earth.

His pursuit of research into radio took him on an expedition to Northern Norway in 1929 to study the Aurora Borealis. In 1931 he published the results of further research on determining the height of reflecting layers of the ionosphere, including the use of a transmitter that sent out " spurts " of radio energy, and the photography of the received echo-signals by cathode-ray oscillography.

Thus, before he had reached the age of 40, he had become one of the great pioneers of radio. The results of his work were already essential equipment for a new generation of radio scientists.

Sir Edward Appleton was born in 1892 in Bradford, Yorkshire. At Cambridge, where he studied under Sir J. J. Thomson and Lord Rutherford, he took the Natural Science Tripos, with Physics for Part II. He returned to Cambridge after the First World War to teach, and in 1924 he was appointed Professor of Physics at London University. He remained there for twelve years until in 1936 he went back again to Cambridge to the Chair of Natural Philosophy. In 1939, he was appointed Secretary of the Department of Scientific and Industrial Research —the senior Government post concerned with physical science.

As Secretary of the DSIR (until his resignation in 1949), he proved that he was also an outstanding administrator. But his heavy administrative duties did not deflect him from research. To him was due the demonstration that ionospheric reflecting power varies with sunspot activity. He also worked on radio reflections of meteorites, and in 1946 he and Dr. J. S. Hey announced their discovery that sunspots are powerful emitters of short radio waves. An important result of his work has been the establishment of a system of ionospheric forecasts, in which more than 40 stations all over the world co-operate, making possible the production of the most suitable wavelengths for communication over any particular radio circuit.

Apart from the Nobel Prize, honours have showered on him throughout his career. He was elected a Fellow of the Royal Society in 1927, shortly after the success of his first big experiments, and in 1941 he was created a Knight. Among many foreign distinctions, he holds the United States Medal of Merit (the highest civilian award) and is an Officer of the French Legion of Honour. He is Honorary President of the International Scientific Radio Union (URSI) and in 1932 he was elected Vice-President of the Institute of Radio Engineers (IRE).

In 1949, he left his Government's service to return to the academic world as Principal and Vice-Chancellor of Edinburgh University, a position which he has held ever since. Those, however, who might be tempted to picture from his amazing record a model of academic dryness and scientific sublimation would be grievously mistaken. One of his great achievements has been his ability to describe the advances of sciences in a way that appeals to the popular mind. This, and his beautiful speaking voice, have made him an outstanding broadcaster and public speaker. Underlying the quietness and tact that has endeared him to all who have worked with him is a dynamically human personality, warm, creative, intellectually versatile and lit up throughout by a built-in sense of humour. It did not need the Nobel Prize to make him one of the elect of our time.

Can two basic "Freedoms of the Seas" be reconciled?

FISHING *versus* CABLES

by C. S. LAWTON

EVEN IN THE EARLIEST DAYS of ocean cables, commercial fishing constituted a hazard, but radical developments have come about in both industries to so aggravate the situation that now it is causing grave concern to the communications companies.

Years ago fishing was carried out with hand lines by small local groups with limited financial resources and little, if any, government assistance. However, the popular realization of the importance of developing this potentially vast source of food has brought with it great emphasis by the governments of the world upon basic research to improve fishing methods, the granting of financial aid to the fishing industry, and exploration of the marketability of a greater number of species.

The introduction of bottom trawling in the early 1900's at once increased the hazard, particularly as (instead of using two ships to keep the net spread between them) most trawlermen tow the net from a single vessel, dragging a pair of Otter boards (Figure 1) along the bottom attached to, but in advance of the outer edges of the mouth of the net, and so oriented as to pull away from the axis of forward movement, exerting thereby enough force to keep the net spread horizontally. The foot-rope of the net is weighed down to keep it on the bottom. Figure 2 shows a board at the "gallows" ready for launching.

The safest bottom for cable is flat and even, irregularities cause suspensions across small concavities. Because cable is inherently stiff and sometimes has a tendency after having been uncoiled from a ship's tank to retain a bit of helical springiness, these suspensions cannot be avoided entirely by laying cable without residual tension. As a matter of fact, if the bottom is sufficiently flat and even, better results sometimes may be achieved by laying it bar-tight.

Naturally, if a cable is not resting on bottom at all points and a trawl board, its lower edge scraping along the bottom, is towed across it where the cable is suspended, the probability of fouling is great, as may be seen in Figure 3. Poor maintenance of the iron shoes which sheath the lower edge of the boards and the bolts which hold them in place, as well as the shape of the boards

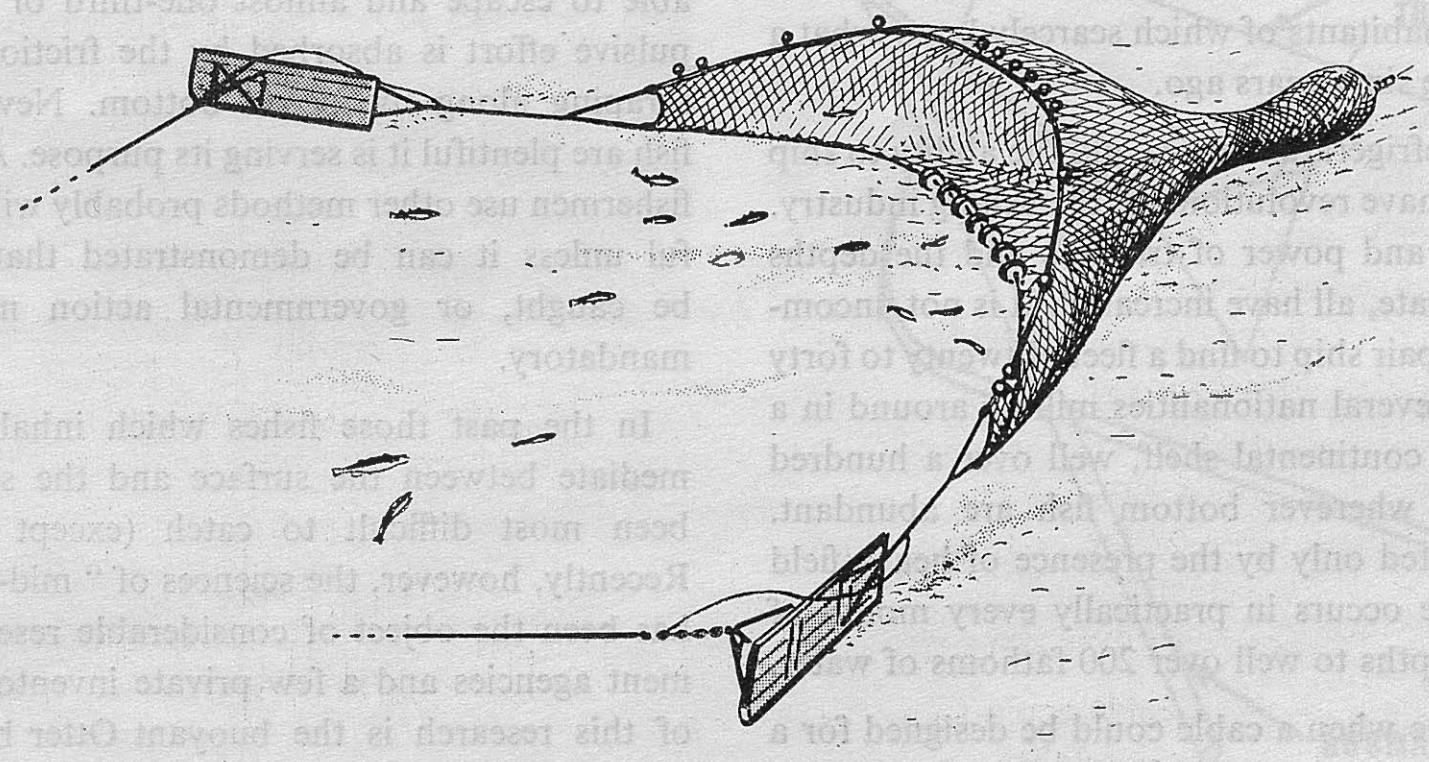


Figure 1. — A pair of Otter boards

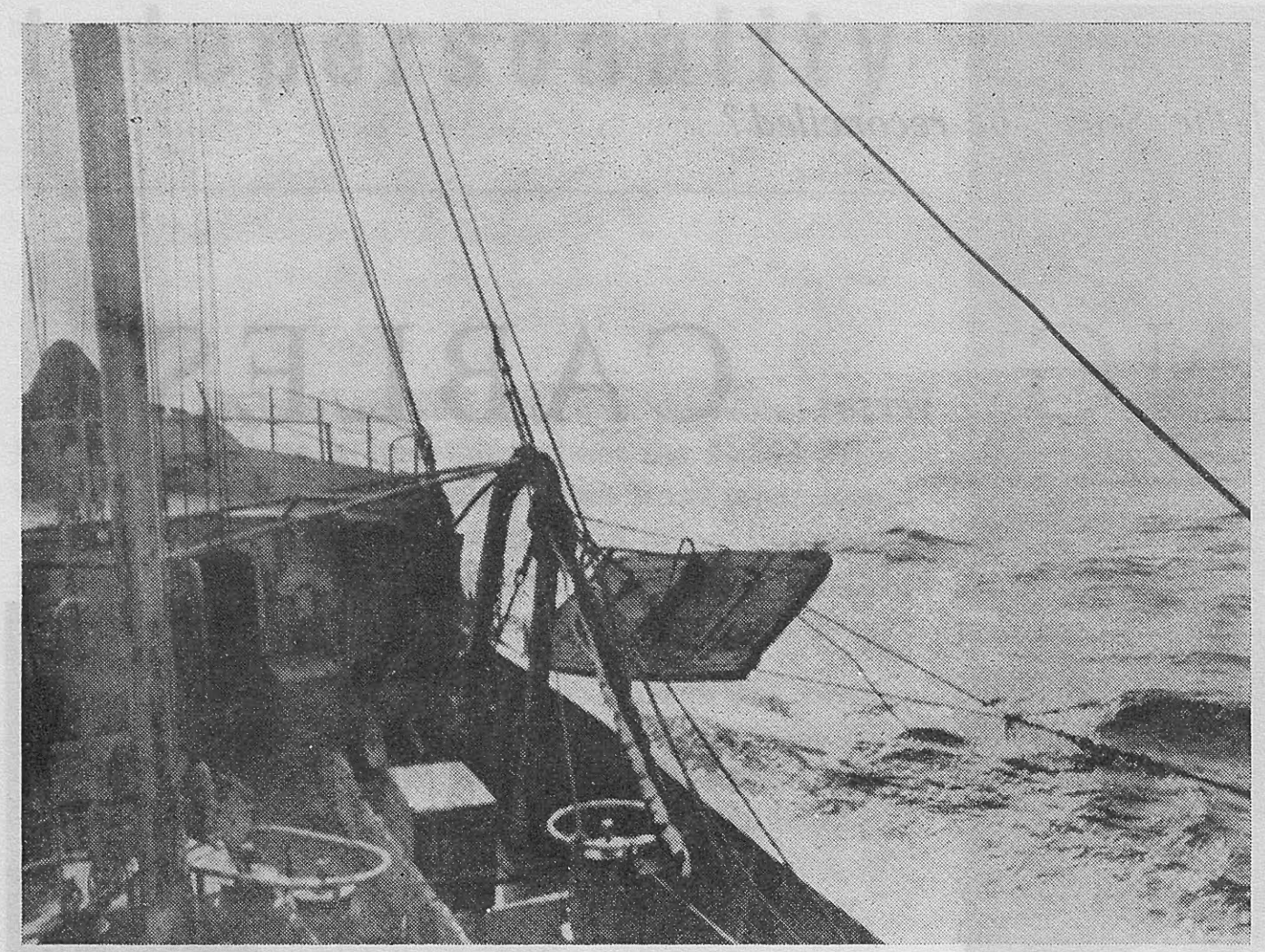


Figure 2. — An Otter board ready for launching

(Photo : US Department of Interior. Fish and Wildlife Service.)

themselves and their attachments, often are contributory factors, but the chief causes of fouling reside in

a) the cableman's inability to make cable conform closely to the contour of the sea bottom and

b) the fisherman's conviction that the boards cannot be towed off bottom and still function properly.

(The causes are placed in that order since many existing cables antedate the invention of the bottom trawl.)

The fishermen's stock argument runs: " The fish were here before the cables ", but even this " ain't necessarily so ". Fish have a way of migrating from one area to another with minor changes in water temperature brought about by shifting currents which carry their food (plankton) and by the gradual melting of the polar ice caps. As an instance of the latter, Cape Cod, Massachusetts, the waters around which were teeming with codfish when the Cape was named, supports little commercial cod-fishing today whereas this fish is plentiful in the waters around southern Greenland, the inhabitants of which scarcely knew what a codfish looked like sixty years ago.

The advent of refrigeration at sea and the ability to ship frozen fish inland have revolutionized the fishing industry. The number, size and power of trawlers and the depths in which they operate, all have increased. It is not uncommon for a cable repair ship to find a fleet of twenty to forty large trawlers of several nationalities milling around in a small area on the continental shelf, well over a hundred miles from land, wherever bottom fish are abundant. The season is limited only by the presence of heavy field ice. Cable damage occurs in practically every month of the year and in depths to well over 200 fathoms of water.

There was a time when a cable could be designed for a reasonable degree of protection by sheathing it with heavy wire armor. That day has passed. Some of the modern trawlers and their gear are so powerful that they can break the strongest communication cables, in some cases possibly without even being aware of them. These cables have tensile strengths on the order of twenty tons or more but under certain conditions it takes less than the full tensile strength of a cable to break it. (Figure 4.)

We are all aware of the tremendous increase in the capacity of modern coaxial lines and the growing importance of cable communications which have paralleled the vigorous growth of the fishing industry. Because two of the basic concepts of the Freedom of the Seas: the freedom to lay cables and the freedom to fish, are in serious conflict, the problems at issue must be resolved on an international basis if substantial improvement is to follow.

Efforts have been, and are continuing to be made to re-design the Otter board. The present bottom trawl is not an efficient tool in that most of the fish in its path are able to escape and almost one-third of a trawler's propulsive effort is absorbed by the friction of the boards scraping along the ocean bottom. Nevertheless, where fish are plentiful it is serving its purpose. Attempts to have fishermen use other methods probably will not be successful unless it can be demonstrated that more fish can be caught, or governmental action makes a change mandatory.

In the past those fishes which inhabit depths intermediate between the surface and the sea bottom have been most difficult to catch (except by hand-lines). Recently, however, the sciences of " mid-water trawling " has been the object of considerable research by government agencies and a few private inventors. One product of this research is the buoyant Otter board which can be controlled so as to operate off bottom. Theoretically

it should be possible to utilize such boards with bottom trawls, since the boards are positioned some distance ahead of the net and a slight upward pull of the boards so positioned should not be enough to lift the heavy weighted foot-rope of the net off bottom. Their elevation by as little as a fathom or two would cause them to ride harmlessly over cables whilst from the fishermen's standpoint there would be either a substantial saving in propulsive effort or a substantial increase in speed of towing (which improves the chances of catching fish).

Other methods of catching bottom fish such as by the use of lights and acoustical effects have not been noticeably successful in the depths with which this article is concerned.

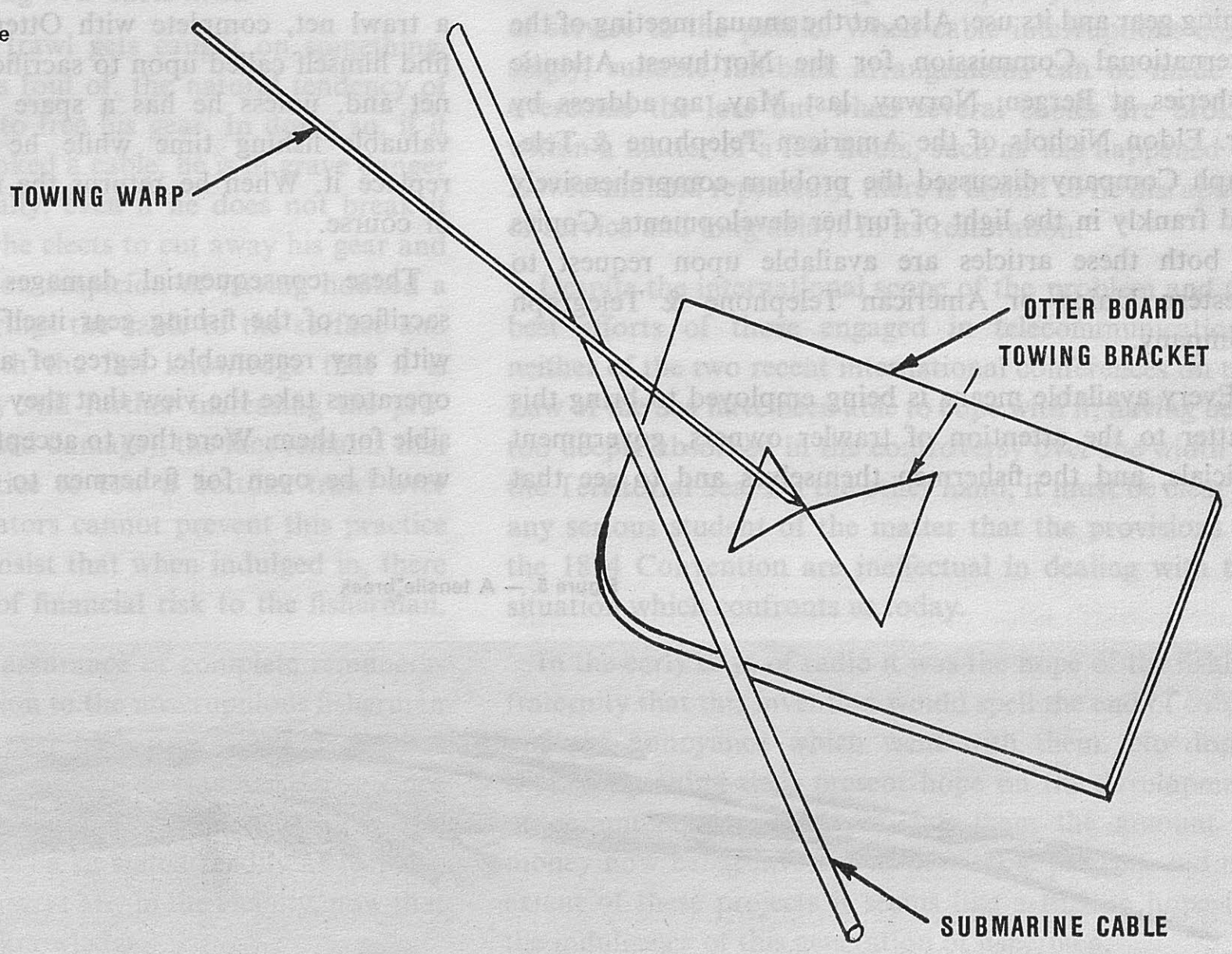
Where the bottom is consistently penetrable to a depth of from 7″ to 24″ and currents are not too strong for a surface vessel to manoeuvre, cables have been successfully buried over distances of about 20 miles in the ocean bottom across a fishing area ranging in depths between 100 and 450 fathoms of water, but this technique is too limited in application in the present state of the art to be of much general assistance. Research is going forward, however, in the extension to deeper water of methods utilizing a bottom vehicle, television-controlled and powered from a surface vessel. The under-water television camera, with its ability actually to photograph cables lying in *situ* and trawl nets in action gives scientists a new and powerful tool for probing these mysteries, but how long it will take to bring about the desired new techniques of cable laying and fishing is anyone's guess. They certainly are not imminent.

To the extent practical, efforts have been made to move cables out of heavily-fished areas. Ten years ago Western Union moved several of its transatlantic cables northward off the east coast of Newfoundland on the advice of government biologists that the cod would never be found there in sufficient density to support commercial fishing. It was known that redfish were there but at that time redfish were not considered too suitable for the market and when caught most of them either were thrown back or used for fertilizer. From about 1956, however, as cod became less plentiful east of Newfoundland and other nationalities sent their trawling fleets across the ocean to fish, the lowly redfish, under the more attractive name of ocean perch, became " socially acceptable " and can now be purchased in frozen form almost anywhere in the United States. The result has been that the cable diversions which were costly and time-consuming to make, afforded only a few years of immunity from damage.

One of the chief complaints of the trawlermen is that unless they have the positions of the cables they cannot very well avoid crossing them, but until quite recently these positions have had to be kept confidential for security reasons. However, the wide-spread damage since the last World War has convinced most governments that the fishermen already have a fair acquaintance with cable routes so that not much is to be gained through continued secrecy.

Now that most of the countries concerned have agreed to eliminate the security restriction it has been possible to publish charts for distribution to trawlermen covering fishing areas where there are cables, showing the route of

Figure 3. — Fouling of a cable



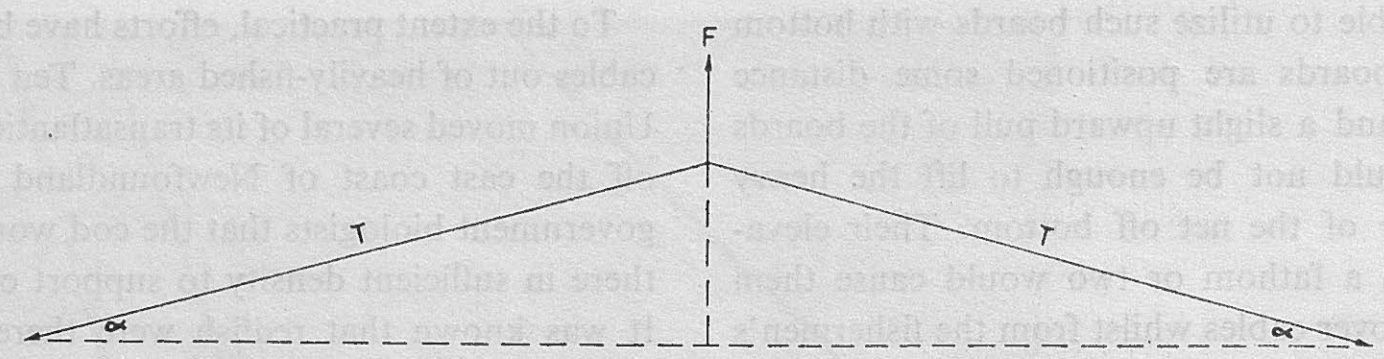


Fig. 4. — Where F = Vertical force required to break cable
T = Ultimate tensile strength of cable
α = Angle of cable to horizontal
Then F = 2 T sin α hence, when α = 30°, F = T
when α = 14 1/2°, F = T/2
when α = 7 2/3°, F = T/4

each cable but without individual identification as to owner or terminal points; cables not now in use are clearly marked, however.

On the western side of the Atlantic, The Western Union Telegraph Company, American Telephone & Telegraph Company and American Cable & Radio Corporation have been working co-operatively on the formulation and distribution of cable charts to ship agents, trawler owners, and governmental agencies associated with the fishing industry. These efforts are being fully co-ordinated with a Cable Damage Committee having headquarters in London and composed of representatives from the British Post Office, Cable & Wireless, and practically all the private cable operators.

At the International Fishing Gear Congress in Hamburg, Germany, in October 1957, a paper was presented by Western Union entitled " Ocean Cables and Trawlers: The Problem of Compatibility " which called attention to the need for a co-operative approach in the design of fishing gear and its use. Also, at the annual meeting of the International Commission for the Northwest Atlantic Fisheries at Bergen, Norway, last May, an address by Mr. Eldon Nichols of the American Telephone & Telegraph Company discussed the problem comprehensively and frankly in the light of further developments. Copies of both these articles are available upon request to Western Union or American Telephone & Telegraph Company.

Every available means is being employed to bring this matter to the attention of trawler owners, government officials, and the fishermen themselves and to see that they are kept fully informed. The October, 1960, issue of the United States Navy Hydrographic Office's Monthly Pilot Chart of the North Atlantic Ocean (H.O. 1400) which circulates widely among mariners, carries on its reverse side an illustrated article entitled " Ocean Cables and Deep-Sea Trawlers " which includes the text of the International Convention of March 14, 1884, for the Protection of Submarine Cables, as evidence that broken cables have been an international problem of long standing.

The twenty-seven signatories agreed that anyone who hooked a cable must sacrifice his gear rather than cut the cable. Cable owners were required to pay for the lost gear.

Appropriate legislation enacted by the member nations still is in force but has done little to alleviate the problem. Before the advent of the botton trawl, ships' anchors had been the chief cause of cable damage, confining it to fairly shallow water. But when a fisherman has to sacrifice a trawl net, complete with Otter boards, he may well find himself called upon to sacrifice a catch of fish in the net and, unless he has a spare set of gear on board, valuable fishing time while he proceeds to port to replace it. When he returns the fish may not be there, of course.

These consequential damages (as opposed to the sacrifice of the fishing gear itself) are difficult to assess with any reasonable degree of accuracy and the cable operators take the view that they cannot be held responsible for them. Were they to accept responsibility, the way would be open for fishermen to ignore the presence of

Figure 5. — A tensile break

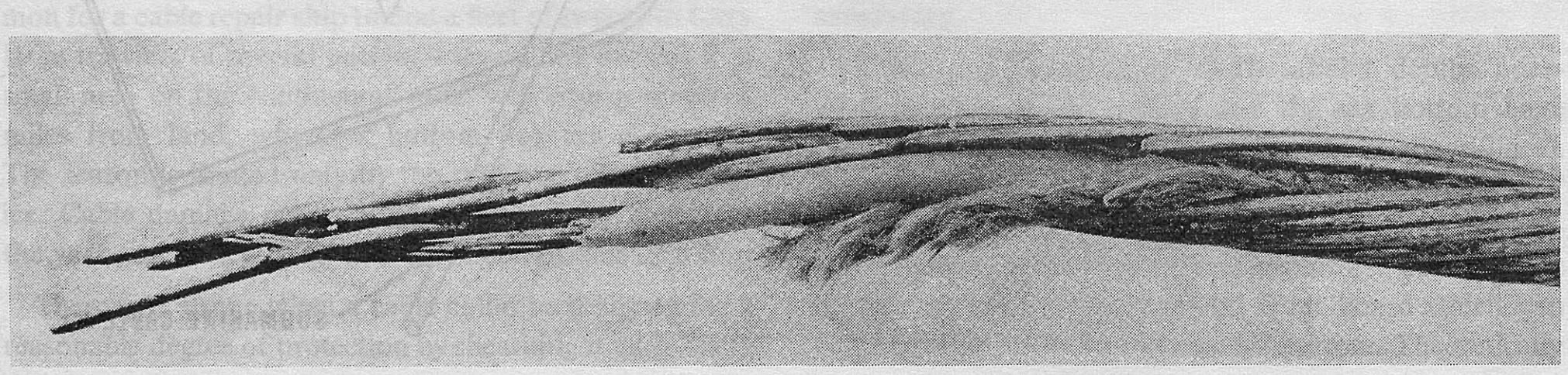


Figure 6. — A flush cut

cables entirely, whereas it is most essential from the cable operators' point of view that there remain some deterrent to the practice of trawling over cable lines.

When a fisherman's trawl gets caught on something, not knowing what he is foul of, the natural tendency of the fisherman is to try to free his gear. In doing so, if it happens that he has hooked a cable, he is in grave danger of damaging it electrically, even if he does not break it entirely. Thus, whether he elects to cut away his gear and claim damages merely on suspicion of having hooked a cable, or whether he brings the cable to the surface and cuts his gear away with the full knowledge that it is indeed a cable (thereby still further increasing the probability that he has caused damage), the fact remains that it is a hazardous practice to tow a bottom trawl over cable lines. Cable operators cannot prevent this practice but they can, and do, insist that when indulged in, there remains some element of financial risk to the fisherman.

Apart from this, the assurance of complete remuneration would be a temptation to the unscrupulous fisherman to claim damages whenever he lost any gear, regardless of whether a cable was the cause or whether the sacrifice had been deliberate, since his geographical position and the depth of water could be so stated readily as to place him over a cable if there were any in the vicinity, now that the routes are common knowledge.

As an example of what can happen, Western Union lost four transatlantic cables in twenty-six hours on 24 and 25 February, 1959, three days after the interruption of TAT 1, the telephone cable laid in 1956 between Canada and Scotland. Six days later (on 3 March) Western Union lost still another. The damage to the telephone cable included a tensile break and a cut less than a mile apart. Damage to the five Western Union cables included ten tensile breaks (Figure 5) and two flush cuts (Figure 6). These cables are armored with No. 1 BWG galvanized steel wires which were in good condition. The depth of water ranged from 170 to 215 fathoms. The telephone cable was out of use for eight days. Western Union lost six days on each of two cables, seven on another, eight on another, and fifty-six on the last one due to an ice field (on the edge of which the trawler evidently had been working) moving over the cable, making it inaccessible for repair.

The repairs required a total of 43 days of ships' time and necessitated the remplacement of 19 miles of cable. The total cost to the cable operators for repairs on this occasion was about $120 000. This, of course, did not include the cost of traffic diversions and hire of alternate facilities where available.

There have been other numerous occasions recently on which multiple damage to several cables has occurred within short intervals of time. In the first ten months of 1960 Western Union cables were individually interrupted or made faulty by trawlers on forty-four occasions, and the telephone cables were broken on several occasions also.

Aside from the cost of repairing cable damage, our concern is with the effect upon the quality and continuity of service to the public. When cable interruptions come singly, suitable fall-back arrangements can be made to overcome the loss but when several cables are broken within a matter of a few hours, such as has happened off Newfoundland repeatedly, there is bound to be disruption of service and long delays in its restoration.

Despite the international scope of the problem and the best efforts of those engaged in telecommunications, neither of the two recent international conferences on the Law of the Sea have been able to cope with it, having been too deeply absorbed in the controversy over the width of the Territorial Sea. On the other hand, it must be clear to any serious student of the matter that the provisions of the 1884 Convention are ineffectual in dealing with the situation which confronts us today.

In the early days of radio it was the hope of the fishing fraternity that this invention would spell the end of cables and the annoyance which went with them. No doubt they are pinning their present hope on the development of communication satellites, but from the amount of money now being invested in new cable projects and the extent of these projects it seems like a forlorn hope for the indulgence of this generation of fishermen.

Mr. Loeber would be most interested in receiving comments on his article from readers. Such comments may be addressed to him care of the Editor of the Journal.

ADMINISTRATIVE RADIO CONFERENCES – *IS IT TIME FOR A CHANGE?*

by CARL W. LOEBER

"THIS IS INTOLERABLE!" exclaimed a well-known delegate to the 1959 Radio Conference as he stood before the bulletin board in the *Bâtiment Electoral*, in Geneva and tried to decide which one of some 25 conference meetings scheduled for the morning he should attend. Another conferee observed that "This must be the last of the general conferences." A third agreed, adding "There must be a better way to revise our regulations."

Comments such as the above were heard throughout the conference. They were based on concern over the length of the conference, the number of experts administrations were required to send, the complexity of the subjects considered, the inability to treat numerous important subjects adequately or even in a cursory manner, the difficulty of small delegations to have a voice in the proceedings of the many groups which met simultaneously, and the pressure under which the conference was required to work for nearly five months. Readers who attended the conference are well aware of these difficulties.

A glance at a few conference statistics reveals the reasons why there was so much conversation regarding this topic in the foyer and around the coffee bar of the *Bâtiment Electoral*.

Excluding the conference secretariat, 798 persons were listed as participating. 697 of these were members of national delegations from 86 countries. 57 delegations were composed of fewer than six members, while there was a total of 104 committees, subcommittees, and working groups. Simultaneous meetings of many of these groups gave rise to serious problems of administration, representation, and meeting space.

In retrospect, the size and complexity of the conference, not to mention its tempo from start to ending, were such as to make one wonder that any coherence and completeness were achieved in the document which was evolved. By comparison with the 1632 regulatory paragraphs and 26 annexes adopted in 1959, the 207 paragraphs and eight annexes approved by the Washington Conference of 1927 were indeed a light task.

Yet, despite the dynamic nature of the radio art and the imperative need for detailed regulations governing the whole sphere of radio-electronics from maritime radio communications to radar and the new earth-space service, we have made little progress in modernizing our procedures for obtaining such regulations.

We still gather more or less regularly to rewrite the entire volume of international radio regulations at a single conference. We must admit that some of our rewriting can hardly be considered an improvement! Furthermore, we still publish the regulations in a format that suggests that all other radio services are merely an adaptation of the maritime mobile service, as was the case fifty years ago. Our regulations therefore are subject to misunderstanding by the uninitiated.

For example, regulations governing the aeronautical mobile service are not to be found in a single chapter clearly labeled as such. Rather, bits and pieces of these regulations are to be found in eleven separate articles scattered throughout the volume.

No wonder then that the 1959 conferees had difficulty in organizing and coordinating their efforts and in drafting a final document. The delegates who believed the 1959 conference should be the last of its kind were realists.

The Alternatives

In the view of those who have given serious thought to the future of ITU radio conferences, a cross road has been reached. The path straight ahead leads to increasingly complex and lengthy conferences. The other path leads to specialized conferences called as necessary to revise specific portions of the regulations and which will require attendance only by those directly concerned with the regulations to be considered.

Clearly, the time has arrived to change our course by choosing the latter alternative, i.e., recognition of the growing need for shorter, specialized conferences. This course has been followed in part since 1947. In the interval between the Atlantic City Conference of that year and the 1959 Geneva Conference five conferences were held to deal with special subjects which could be given more adequate consideration when removed from the hectic atmosphere of "ordinary" conferences. The 1959 Conference provided for three specialized conferences to deal with:

a) Frequency Allocation for Space Communication

b) Revision of the Aeronautical Frequency Allotment Plan

c) Congestion in the High Frequency Spectrum, if such a Conference is recommended by the Panel of Experts.

Codification of the Regulations

A prerequisite to any reorganization of radio conferences is the codification of present regulations so as to place all regulations relating to a particular subject in a single article, chapter, or part. In general, the present regulations may be divided into three categories: those of a general technical or administrative nature affecting two or more radio services, those concerning individual radio services, and those concerned with rates and accounting procedures for public messages and radiotelephone calls.

Such a categorization point to the following classification of subjects:

I *General Regulations*

1. General Technical Regulations
2. General Administrative Regulations
3. Frequency Assignment and Allocation
4. Frequency Notification and Registration
5. Interference and Monitoring
6. Emergency and Safety Communications

II Service Regulations

1. Aeronautical Mobile Service
2. Maritime Mobile Service
3. Amateur Service
4. Experimental Service
5. Radio Determination Service
6. Broadcasting Service
7. Fixed Service
8. Special Services

III Regulations Governing Radio Telegrams and Radiotelephone Calls

It will be noted that almost any one of the above subjects could be treated at a special conference. It will also be noted that no conference time need be devoted to consideration of those regulations not clearly in need of revision. Thus the possibility exists of calling short conferences devoted exclusively to a single subject and requiring the attendance of only those experts directly concerned with that subject.

A Specific Suggestion

Based on lengthy study as well as extensive participation in past conferences, changes in future radio conferences are suggested below for serious study by all administrations. It is noteworthy that, except for changes in the names of the present three types of radio conferences, these suggestions could be put into effect immediately without contravening the Convention of 1959.

It is suggested that General Administrative Conferences replace the present Ordinary Administrative Conferences, Limited Administrative Conferences replace the present Extraordinary Administrative Conferences, and Regional Conferences replace the present Special Regional Conferences.

1. *General Conferences* would have many of the functions now assigned to Ordinary Conferences, including election of members of the IFRB but excluding the general revision of the radio regulations. These conferences would however, be authorized to revise those of the General Regulations referred to above which were deemed to require attention. Ordinarily, the agendas of General Conferences would be subject to the prior agreement of a majority of the administrations of member countries so as to clearly define the tasks to be undertaken. An additional task for General Conferences would be the resolution of any difficulties or inconsistencies arising from the decisions taken by Limited or Regional Conferences.

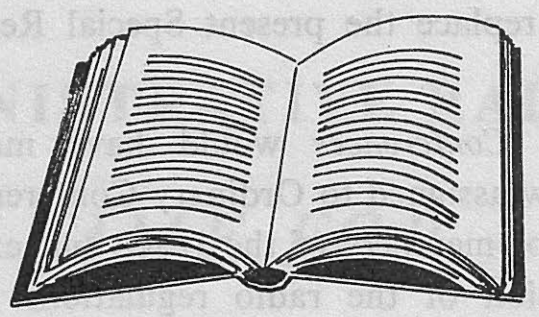
2. *Limited Conferences* could be called at any time to consider any one or several of the categories of General or Service Regulations. Their agendas would, of course, be subject in all cases to prior agreement by a majority of the administrations of member countries. The decisions taken at such conferences would be final, except when those decisions may be in conflict with other regulations then in effect. In such cases, the conflict would be referred to the next General Conference as indicated above. It goes without saying that conferences concerned only with particular radio services would not adopt changes affecting the General Regulations or Regulations of radio services. Limited Conferences could, however, adopt any recommendations deemed necessary or desirable regarding amendment of other regulations.

3. *Regional Conferences* would be called to deal with regional problems in precisely the manner followed in the past. These conferences would not be authorized to revise any regulations adopted by Limited or General Conferences, but would be called for the specific purpose of solving problems unique to a region or area.

Pending revision of the 1959 Convention, the foregoing suggestions could be adopted through the simple expedient of calling no more " ordinary " radio conferences and by regarding future conferences other than regional conferences, as " extraordinary " within the meaning of the 1959 Convention. The agendas for such conferences would be clearly confined to specific tasks and would have prior approval of administrations.

Obviously many detailed considerations are necessary in connection with the above concept for future radio conferences, and only the broad outlines can be given in this paper. However, the subject is one which warrants most serious consideration by all administrations if the international regulations are to keep space with the rapidly developing complexity of the radio-electronic art.

BOOKS



Current Trends in Scientific Research [1], by Pierre Auger, Special Consultant, UNESCO.

In 1960 the General Assembly of the United Nations decided that a study should be made on present trends in scientific research, on the dissemination and application of science for peaceful ends. Professor Pierre Auger, the eminent physicist and former director of the UNESCO Department of Natural Sciences, was asked to assemble the information and draft the report. Nearly a hundred international organizations and fifty national organizations interested in research were consulted, as were 255 individual experts in all countries.

In his preface, Professor Auger explains that the general outline of the survey was based on a functional division of scientific research rather than on a purely academic classification of sciences. Hence, a study was made of man's needs, corresponding to the institutional structures usually adopted for scientific research at the national and international level.

An introduction gives the reader a survey of the work of various branches of science and of the general growth of the scientific movement throughout the world. This growth, which is 10% per annum, has more than doubled in ten years. Whereas in 1850 there were only a thousand scientific reviews, there are now nearly 100 000, which makes it impossible for anyone even to keep abreast of scientific activity.

The report is in three parts. The first: " Trends of scientific research," has six main headings. I. The Fundamental Sciences; II. The Earth and Space Sciences; III. The Medical Sciences; IV. The Food and Agricultural Sciences; V. Fuel and Power Research; VI. Industrial Research. It is under this last heading that there is an article on telecommunication research (which we publish on page 57). The second part deals with the main trends affecting the organization of scientific research and the dissemination of results, and the third deals with general and specific recommendations concerning scientific research, the dissemination of scientific knowledge and its application for peaceful ends. The recommendations cover both the scientific policy of States and the extension of spheres of activity.

This work, the first of its type, will probably also be one of the most important basic scientific works of the next ten years.

V. M.

[1] *Current Trends in Scientific Research*. 245 pages. 27 × 21 cm. UNESCO, Paris, and the United Nations, New York, 1961. Price: NF 17.75; 25 sh.; $5.

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Introduction to Laplace transforms for radio and electronic engineers by W. D. Gay [1]

In his preface, the author recalls that the need for a text on the Laplace transformation which could be read by engineering students, who have a working knowledge of circuit principles, but whose mathematics does not go beyond elementary differential equations and the properties of complex numbers, has long been apparent. This book will provide a suitable introduction to the subject for such students and lecturers will find it an adequate first working text.

The method is approached via the solution of second order equations rather than through the Fourier Integral and Transform, as this seems easier for students in the initial stages, and enables them to solve familiar problems by means of a technique of which they have some appreciation straight away.

The treatment is not rigorous, and even formal proofs are omitted where they add little to the understanding. Engineers are usually willing to accept statements which appear reasonable and will more readily study the mathematics in greater detail after they have found that the method is of real help to them in practical problems.

The arrangement is such that the first five chapters are self-contained, and will serve to give the reader some facility in the use of transforms, without the introduction of complex variable theory and the Inversion theorem.

The second half of the book is far less complete, as it is felt that once the reader has grasped the ideas behind the Inversion theorem and the Product theorem, he will find that other texts will be readable and rewarding. The latter chapters are intended to introduce the reader to such texts and a great deal has been omitted which might well have been included in a more complete, and therefore more expensive treatment. Examples are confined to the electrical field, and in particular to those problems of interest to the communications engineer.

The bibliography at the end makes suggestions to the reader who desires a better understanding of the subject. V. M.

[1] One bound volume. 183 pages. 22 × 15 cm. Published by Iliffe and Sons Ltd., Dorset House, Stamford Street, London, S.E.1, and by Interscience Publishers Inc., 250 Fifth Avenue, New York N.Y. 1960. Price: 32s. 6d. (33s. 6d. by post).

★ ★ ★

Learning Morse, 13th edition, by H. F. Smith.[1]

This booklet will be a helpful guide to all wishing to master the international signal code. It gives methods of learning the code, key manipulation and methods of practice. There are also details and descriptions of equipment, and of an easily constructed transistorised practice set complete with a schematic drawing of the layout and circuits. The International Morse Code is given in full. The booklet also includes the revised Q code (as approved at the Geneva Administrative Radio Conference, 1959) which came into force on 1 May, 1961, and a set of practice exercises. V. M.

[1] A booklet; 20 pages. 18.5 × 12 cm. Published for " Wireless World " by Iliffe Books Ltd., Dorset House, Stamford Street London, S.E.1. Price, including postage, 1s. 10 d.

telecommunication research

Reproduced from the United Nations—UNESCO survey

" Current Trends in Scientific Research ",

by Professor PIERRE AUGER, Special Consultant

Telecommunication research is based on extensive studies in the fields of physics, chemistry, metallurgy and mathematics. This point may be illustrated, *inter alia*, by the following examples:

a) As a result of investigations into the physical properties of solids, new methods of determining the purity of substances by physical and chemical analysis offer extensive prospects for research on the functioning of hot cathodes.

b) The fundamental study of junctions in semiconductors and of the emission of recombination light.

c) Cascade phenomena, which are extremely important in the study of electron emission by semiconductors.

d) Study of the physical phenomenon of electro-luminescence and the intermediate energy levels which may exist in it. Using the substances involved, it will also be possible to initiate research on photo-voltaic, photo-resistive, photo-piezo-electric and other effects.

e) Study of the physical phenomena underlying parametric amplification and of such substances as the rare earth ferrites.

f) The possibility, particularly in the case of semiconductors, of making joint practical use of apparently distinct phenomena such as magneto-resistivity, electrostatics and electro-resistivity—considerable resources are to be devoted to the quest for the substances best calculated to produce and emphasize these joint phenomena.

g) Very thorough study of the electron energy of atoms and the corresponding transitions between different levels—scheduled for even more active pursuit in coming years.

h) Plasma physics, which are of great interest for telecommunications in view of the possibility of employing plasmas in the generation of ultra-short waves and of their physical properties with reference to the propagation of electro-magnetic waves in a plasma medium.

i) Research on the theorems governing the electromagnetic operation of both active and passive multipolar electricity networks (filters, equalizers, etc.) in all frequency ranges.

j) Lastly, information theory is important in determining the optimum coding of signals and eliminating redundancies.

Applications

The following are the four main fields of application of technical and scientific research into telecommunication:

a) The preparation and arrangement of information at the point of emission in a form appropriate for transmission, and its reconstitution at the reception point.

b) The transmission of information through media using their intrinsic physical (e.g., acoustical or electromagnetic) properties.

c) The transmission of information by conductors (guided transmission).

d) The control and distribution of information.

Research in these fields is a corollary to fundamental physical and chemical research on the substances or phenomena used in setting up information processing systems.

Preparation and arrangement of information

Information can be divided into two main categories: static information (texts, photographs, etc.) and kinetic information (television, telephone, etc.).

Fundamental research in both categories is concerned with studying the basic nature of the information in

question, in an attempt to eliminate all non-essentials. The optimum coding of information is an aim that is close to realization for the first category but still remote for the second. This is because the coding of static information increases the efficiency of the frequency bands used in transmission, whereas the coding of kinetic information has so far resulted in a loss.

Research in this field is generally concerned with analog or digital conversions. Digital conversions are easier to handle in the different forms of automatic processing to which more and more information is being subjected every day.

Transmission of information through various media

Research in this field involves the study of different media, of which the most important from the stand-point of radiocommunications are at present: *a)* the lower atmosphere; *b)* the upper atmosphere and outer space.

Fundamental research on the atmosphere includes the study of wave propagation in relation to meteorological, climatic and topographical data, and attempts at the theoretical explanation of the phenomena observed, for bands of frequencies ranging up to millimetric waves.

Particular study is being devoted to the structure of the electromagnetic field in time and space and its correlation with the physical phenomena which appear to govern it.

This line of research includes the study of the phenomenon of so-called wave scattering, which has not yet been clearly understood or explained.

Corollaries of this research are the production and conditioning of millimetric, coherent submillimetric and infra-red waves, as well as the study of natural radiation, which is at the origin of background. The nuisance value of background will become all the more apparent when, as seems probable, other interference in wave-reception systems is considerably reduced.

A great deal of attention is being paid to the upper atmosphere and outer space and research tends to be concentrated on subjects which have some application to telecommunication and electronics: radiocommunication, radiolocation, radionavigation, transmission and detection in infra-red.

Work now in progress falls into four categories:

a) General research on propagation, the transmission of information and observation of the upper atmosphere by radio and infra-red waves.

b) Research into the influence on propagation of artificial disturbances in the ionosphere. Particular attention will be paid to the artificial ionization of zones in the upper atmosphere by the ejection of suitable material (which can be ionized by the ultra-violet rays of the sun) from rockets, or by violent explosions. The characteristics of the phenomena and their effects on radiocommunication will require detailed study.

c) Research on long-distance links by very-short-wave radio, using the moon or artificial satellites as passive reflectors or active retransmitters; this type of link appears to have great prospects for the routing of many telephone messages or for long-distance television, especially across the Atlantic.

d) Study of the atmospheric wave-guides, which may exist more or less permanently in the supermarine atmosphere, with a view to learning more about the propagation of electromagnetic waves of certain lengths.

Transmission of information by conductors

Applied research and technical development in this field are subject to the economic considerations which govern investment in transmission networks.

The basic equations and mathematical theorems on wave propagation on or in conductors or dielectrics satisfactorily express the relevant phenomena even when damping is involved. Consequently research in this field is based on long-term investigations into the structure of transmission lines (coaxial lines, circular wave-guides, etc.); the composition of amplifiers, the development of which will be profoundly influenced by the introduction of semiconductors; and the structure of the so-called " networks " (electric filters, phase or amplitude equalizers, etc.).

The transmission lines receiving the closest attention are those of transoceanic submarine cables, for which an attempt is being made to extend the available frequency band to the maximum. Research in this field is mainly concerned with the problem of the ageing of materials and parts used in the lines and in the corresponding amplifiers under mechanical pressures ranging up to several hundred kilograms per square centimetre. Under such operating conditions the physical and chemical stability of dielectrics consisting of long-chain molecules, such as the ethylene polymers, still presents a problem.

Control and distribution of information

This is the province of automation. Control, logic and storage are governed by internal programmes based on a distribution of external information which has been subjected to appropriate logical analysis and stored for short or long periods.

Current work in this field includes fundamental studies on the application of solid state physics to storage phenomena (electro-luminescence, ferromagnetism, ferroelectricity, etc.) and to static binary systems of control, and also technical research into the design of large-scale calculating and control units capable of switching information and distributing it to users with increasing rapidity and economy and with the greatest possible efficiency.

In short, the present trend is to replace electro-mechanical automatisms by highly durable electronic automatic equipment which is quick and reliable in operation. This should require a smaller, though more highly qualified, maintenance staff and should provide users with a swifter, easier and more convenient transmission of information.

REVIEW REVIEW

A list of articles in other technical publications which may be of interest to readers of the Journal.

The articles are listed under the language of the publication.

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50 YEARS AGO

Telegraph Legislation

GREECE

Persons who in any capacity possess property in town or country will have to tolerate the laying of State telephone lines above or below ground, the erection or installation of poles, masts, and brackets, the laying of cables, and line-maintenance supervisory activities, in accordance with this Decree.

★★★

Radiotelegraphy and Polar Expeditions—Henceforward explorers in the polar regions will not be without any means of communication. Expeditions in the Arctic Ocean will be able to communicate with a radiotelegraph station (with a radius of action extending beyond the Pole) in Spitzbergen. Other stations are to be set up in Iceland and Greenland.

From the *Electrician* and the *Blätter für Post und Telegraphie* we learn that the governments of Argentina and Australia intend to set up stations as close as possible to the South Pole. The Argentine station is to be erected on one of the Año Nuevo islands off Tierra del Fuego, while the Australian one is to be on Macquarie Island, some 850 miles from the Polar Circle.

★★★

JOURNAL TÉLÉGRAPHIQUE — FEBRUARY 1912

OFFICIAL ANNOUNCEMENTS

INTERNATIONAL TELECOMMUNICATION CONVENTION, GENEVA, 1959

The Government of the United Kingdom of Great Britain and Northern Ireland has ratified the International Telecommunication Convention of Geneva (1959), the Final Protocol and the Additional Protocols annexed thereto, on behalf of **British East Africa** (comprising: Colony and Protectorate of Kenya, Tanganyika (Territory under United Kingdom Trusteeship), Protectorate of Uganda).

The instrument of ratification has been deposited with the General Secretariat of the Union on 30 November 1961.

CONVENTION ON THE PRIVILEGES AND IMMUNITIES OF THE SPECIALIZED AGENCIES

The Convention on the Privileges and Immunities of the Specialized Agencies entered into force on 13 November 1961 between the Government of **Kuwait** and the International Telecommunication Union.

Invitations accepted to conferences or meetings external to the Union

Date	Organization	Nature of conference or meeting	Place	Representatives
1962				
24 January-6 February	UNESCO	Meeting of experts on development of information media in Africa	Paris	Mr. Gerald C. GROSS (Secretary-General) Mr. F. ZUBER (ITU's expert)
12-19 February	Economic Commission for Asia and the Far East (ECAFE)	Tenth session of the Inland Transport and Communications Committee	Bangkok (Thailand)	Mr. Thomas R. CLARKSON (ITU's expert)
6-19 March	Economic Commission for Asia and the Far East (ECAFE)	Eighteenth Session	Tokyo	Mr. Thomas R. CLARKSON (ITU's expert)

Calendar of ITU conferences and meetings

Date	Title	Place
1962	**International Telegraph and Telephone Consultative Committee (CCITT)**	
22 January-2 February	Plan Sub-Committee for Africa	Dakar
1-7 February	Restricted Working Party of Study Groups IX and Special A (Definitions for data transmission)	Geneva
6-10 February	Working Party of Study Group XV (Transistor systems on symmetrical pairs)	Paris
8-14 February	Working Party of Study Group X (Intercontinental gentex and telex switching)	Geneva
12-19 February	Working Party of Study Group VII (Definitions)	Geneva
15-21 February	Working Party of Study Groups I and X (World telex routing plan)	Geneva
20-23 February	Working Party of Study Group VII (Symbols)	Geneva
22 February-1 March	Working Party of Study Groups I, VIII and X (Retransmission of messages)	Geneva
2-8 March	Working Party of Study Groups VIII, IX and X (Synchronous telegraphy)	Geneva
9-13 March	Working Party of Study Group VIII (Apparatus for more than 50 bauds)	Geneva
27 March-5 April	Working Party of Study Group V (Revision of *Directives*)	Geneva
28-31 March	Working Party of Study Group III (Costing of automatic telex calls)	München
April	Plan Sub-Committee for Latin America and RIT Study Group (Interamerican telecommunication network)	Bogotá?
25-27 April	Working Party of Study Group XV (12 Mc/s systems)	Geneva
30 April-2 May	Working Party of Study Group XV (Small coaxial pairs)	Geneva
4-6 June	Working Party of Study Group XII (Laboratory)	Geneva
7-15 June	Study Group XII (Telephone transmission performance)	Geneva
11 June-6 July *	Study Group XI and Working Party of Study Group XI (Telephone switching)	Montreal
	Study Group XIII and Working Party of Study Group XIII (Automatic and semi-automatic networks)	
	Study Group XVI (Telephone circuits)	
	Working Party of Study Group IV (Intercontinental maintenance)	
	Working Party of Special Study Group B (World automatic and semi-automatic telephone network)	
	International Radio Consultative Committee (CCIR)	
12-23 February	Study Group IX (Radio relay systems) and CMTT (Joint Commission for Television Transmissions)	Paris
12-23 March	Study Group IV (Space systems) and Study Group VIII (International monitoring)	Washington
4-18 April	Study Group I (Transmitters) and Study Group III (Fixed Service systems)	Geneva
25 April-4 May	Study Group V (Propagation, including the effects of the earth and the troposphere) and Study Group VII (Standard-frequencies and time signals)	Geneva
7-18 May	Study Group II (Receivers)	Geneva
7-23 May	Study Group VI (Ionospheric propagation)	Geneva
13-29 June	Study Group X (Broadcasting Study Group XI (Television) Study Group XII (Tropical broadcasting)	Bad Kreuznach
5 May-June	**ITU Administrative Council** (17th session)	Geneva

** The exact details for these meetings at Montreal will be fixed later*

INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)

Smoothed monthly sunspot numbers

1st February 1962

Predictions for the coming months:

1962	**February**	**36**	**March**	**35**	**April**	**33**
	May	**31**	**June**	**30**		

(Values kindly provided by Prof. Waldmeier, Federal Observatory, Zurich)

List of recent and forthcoming publications of the International Telecommunication Union

Note. — A comprehensive list of all the publications of the Union will be supplied free on request.

The following letters indicate the languages in which documents are published :

(F) *for French* **(S)** *for Spanish* **(C)** *for Chinese*
(E) *for English* **(R)** *for Russian*

Prices are in ***Swiss francs.***

I. Publications issued since the last number of the Journal

Official List of telegraph offices open for international service (two volumes), 21st edition, October 1961
Preface in separate languages : Dutch, English, French, German, Italian, Polish, Roumanian, Russian and Spanish, and trilingual preface in French, German and Italian.
Price, including annexes to be published before the next edition :

paper backs : 42.50 Sw.fr.
cardboard cover : 45.20 Sw.fr.
cloth boards : 47.70 Sw.fr.

Copies on stout paper may be obtained for an extra 4.30 Sw.fr. per copy in so far as stocks permit.

Tentative high frequency broadcasting schedule (M,1962)
Period : 4 March-6 May 1962
Trilingual edition **F, E, S.**
Price : 13.85 Sw.fr.

Summary of Monitoring information received by the IFRB No. 66 (November 1961)
Trilingual edition **F, E, S.**

International Frequency Registration Board (IFRB):

Preface to the International Frequency List, first edition combined with Supplement No. 1, 1st August 1961.
Editions in separate languages **F, E, S.**

II. Forthcoming publications

International Frequency List, 1st edition, 1961.
Vols. II, III.
Multilingual edition in **F, E, S, R, C.**

Summary of Monitoring information received by the IFRB.
No. **67** (December, 1961).
Trilingual edition **F, E, S.**

High frequency broadcasting schedules (4 publications per annum).
Trilingual edition **F, E, S.**

List of International Monitoring Stations, 1st edition, September 1961.
Trilingual edition **F, E, S.**

General telegraph statistics, 1960

List of international telex circuits, 1960

List of international telephone routes, 2nd edition.
Trilingual edition **F, E, S.**

Green Table, 1st series.
Optional provisions of the Radio Regulations (Geneva, 1959).
Trilingual edition **F, E, S.**

Alphabetical List of call signs, 1st edition (2 vols. List VII.A, List VII.B).
Multilingual edition **F, E, S, R, C.**

International Telegraph and Telephone Consultative Committee (CCITT)

Directives
Editions in separate languages **F, E.**

II Plenary Assembly, New Delhi, 1960.

Red book
Vols. I bis, II bis, IV, VI and VII.
Spanish edition.
Vols. III and V.
Editions in separate languages **F, E, S.**

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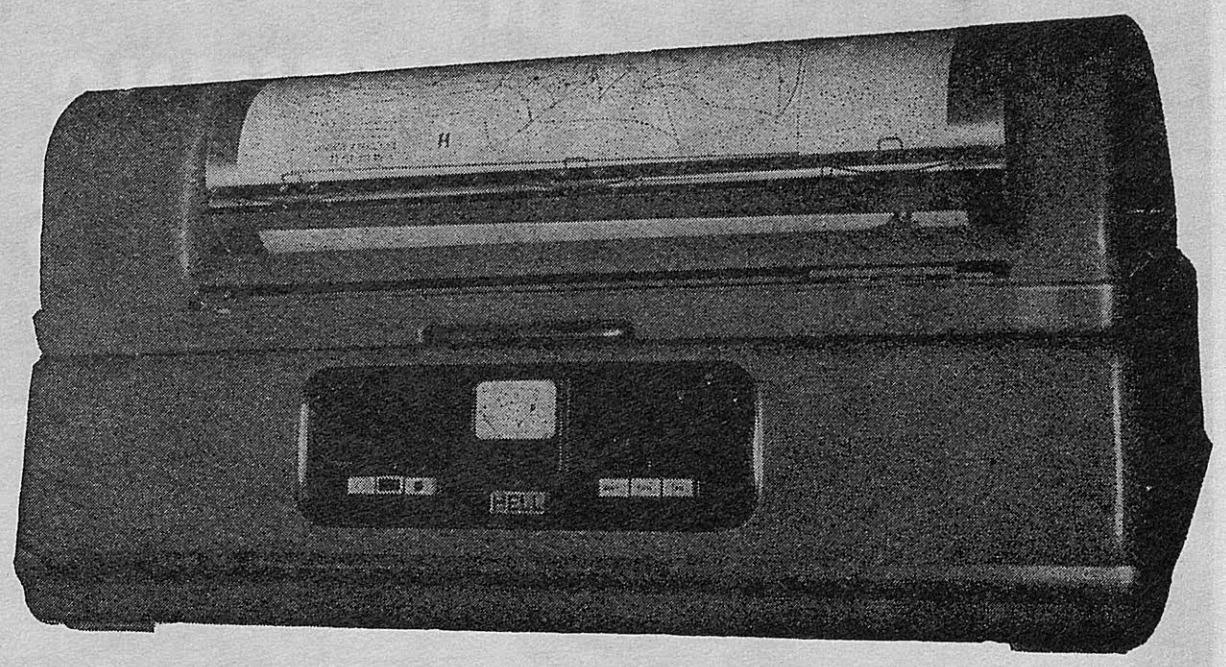

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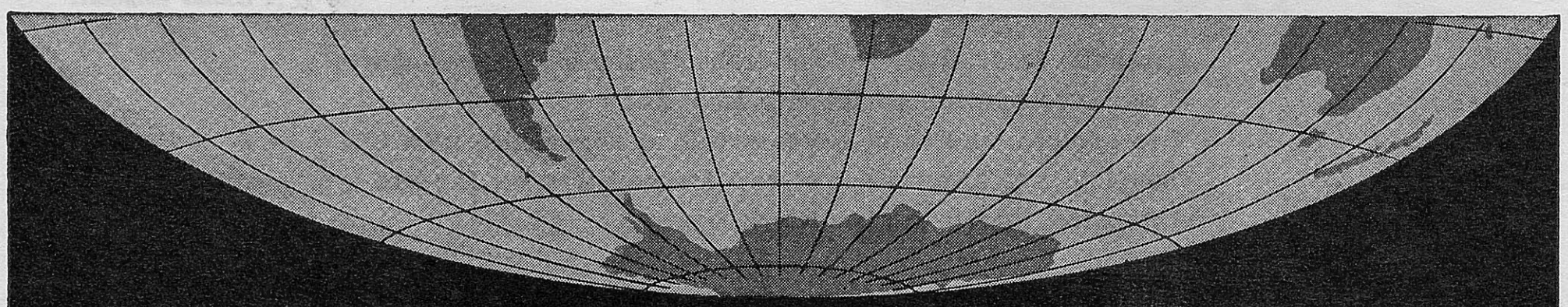

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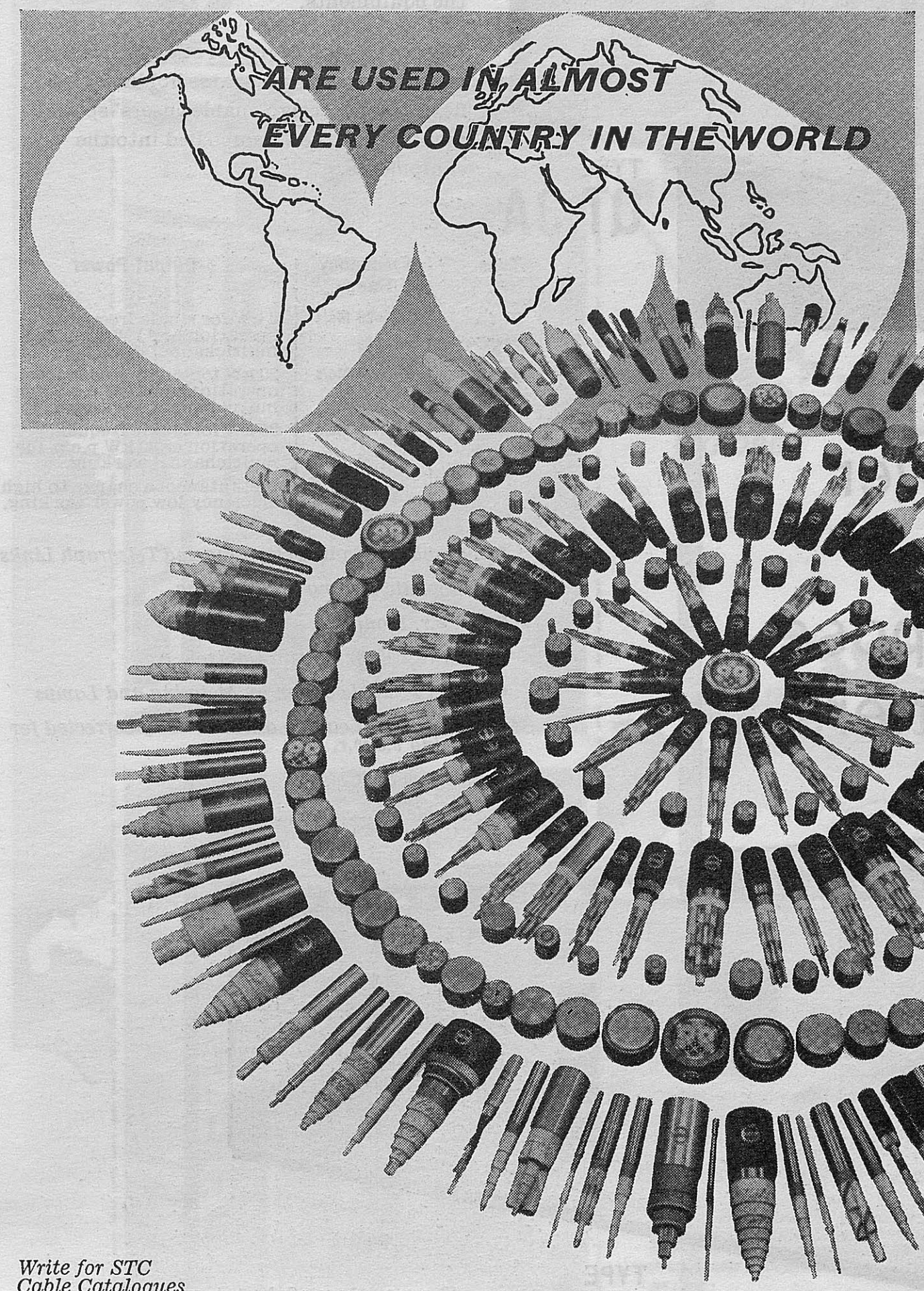

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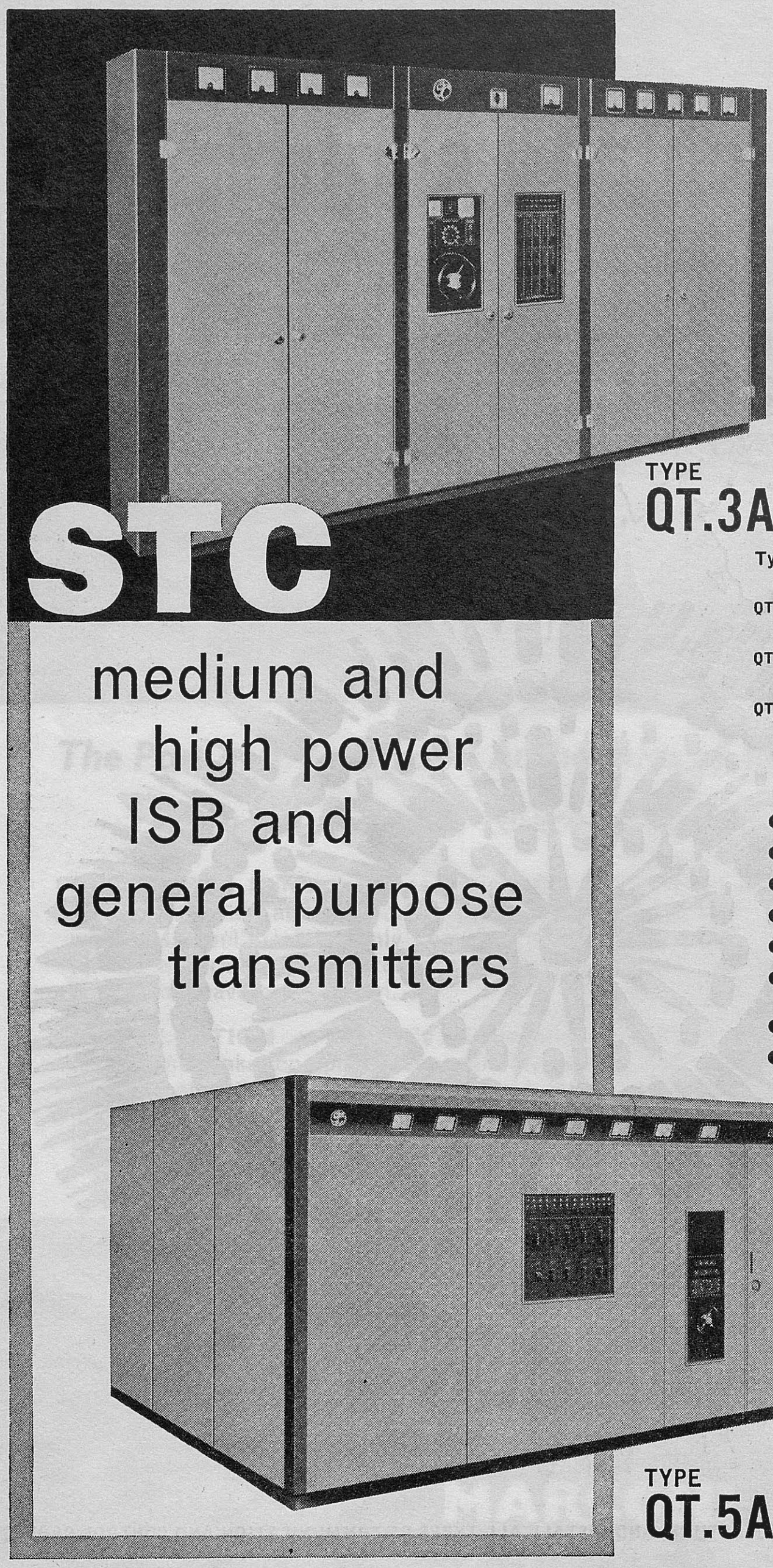

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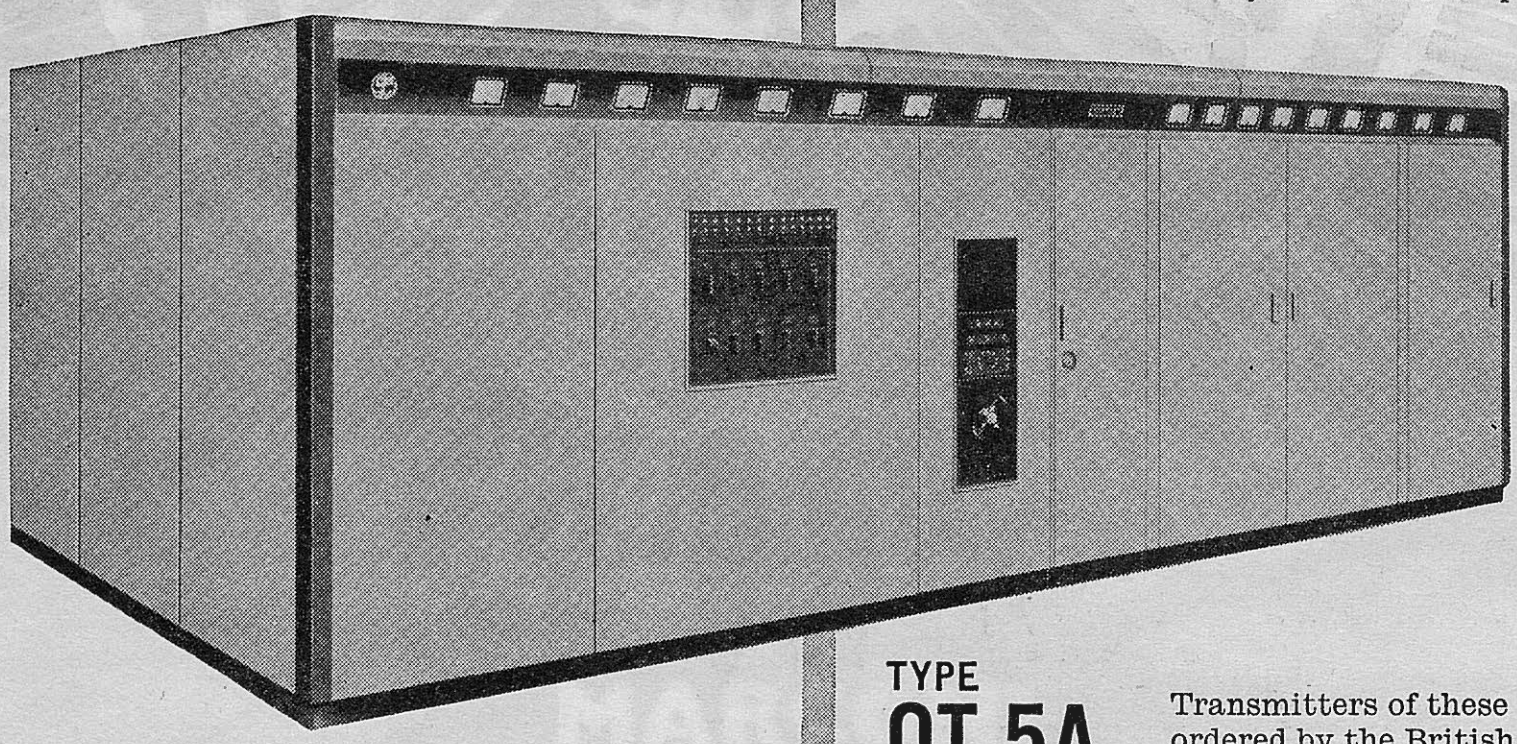

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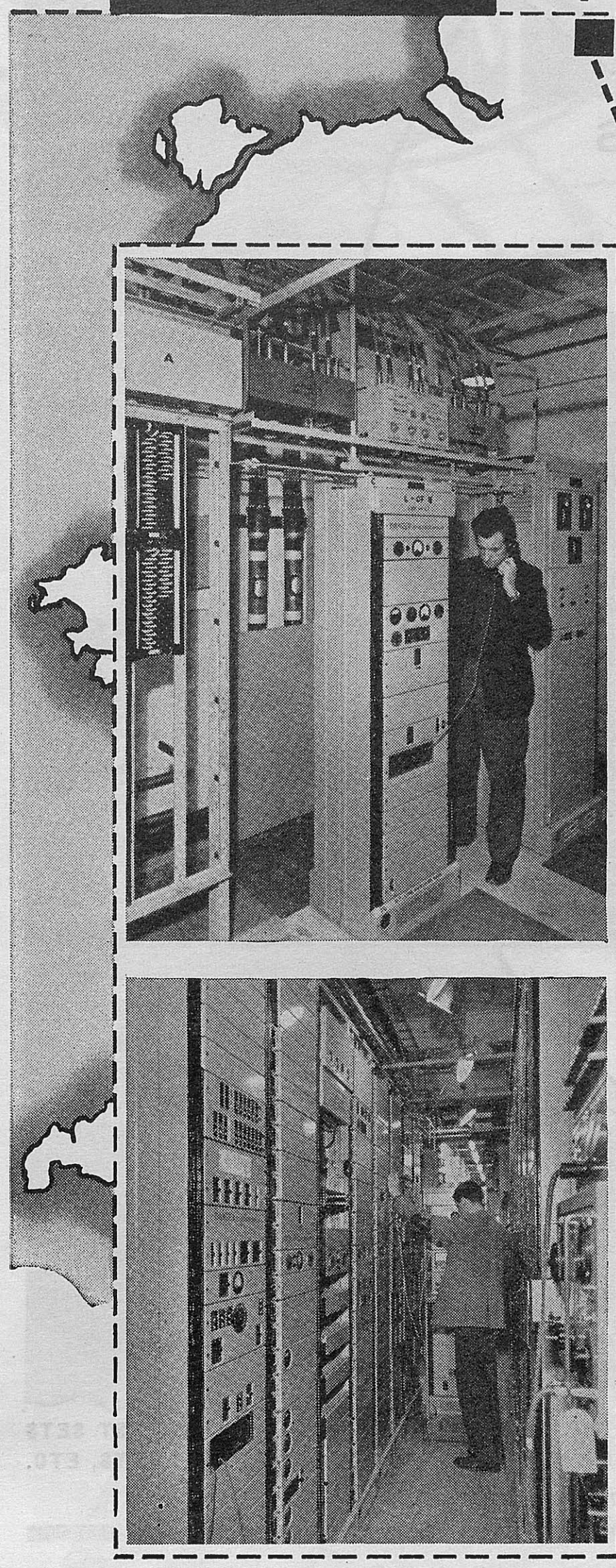

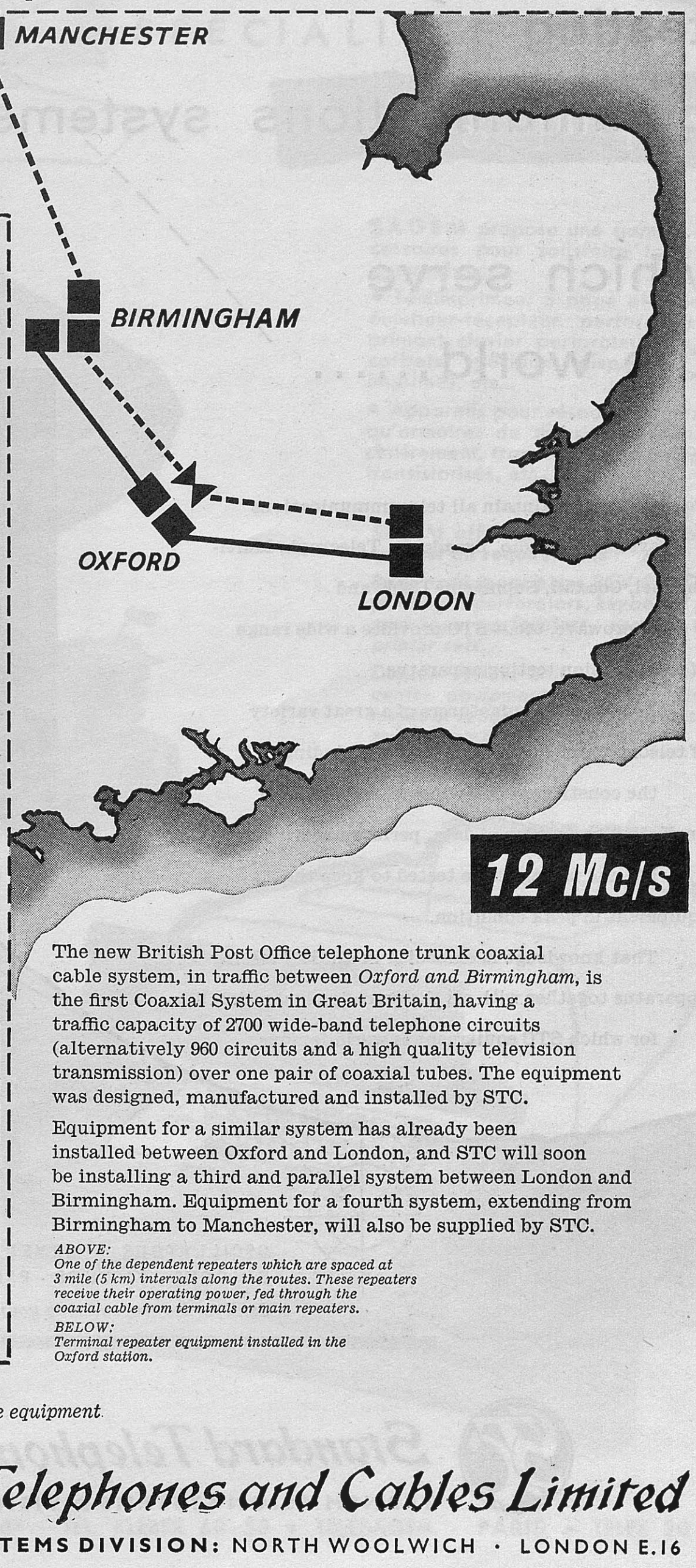

The new British Post Office telephone trunk coaxial cable system, in traffic between *Oxford and Birmingham*, is the first Coaxial System in Great Britain, having a traffic capacity of 2700 wide-band telephone circuits (alternatively 960 circuits and a high quality television transmission) over one pair of coaxial tubes. The equipment was designed, manufactured and installed by STC.

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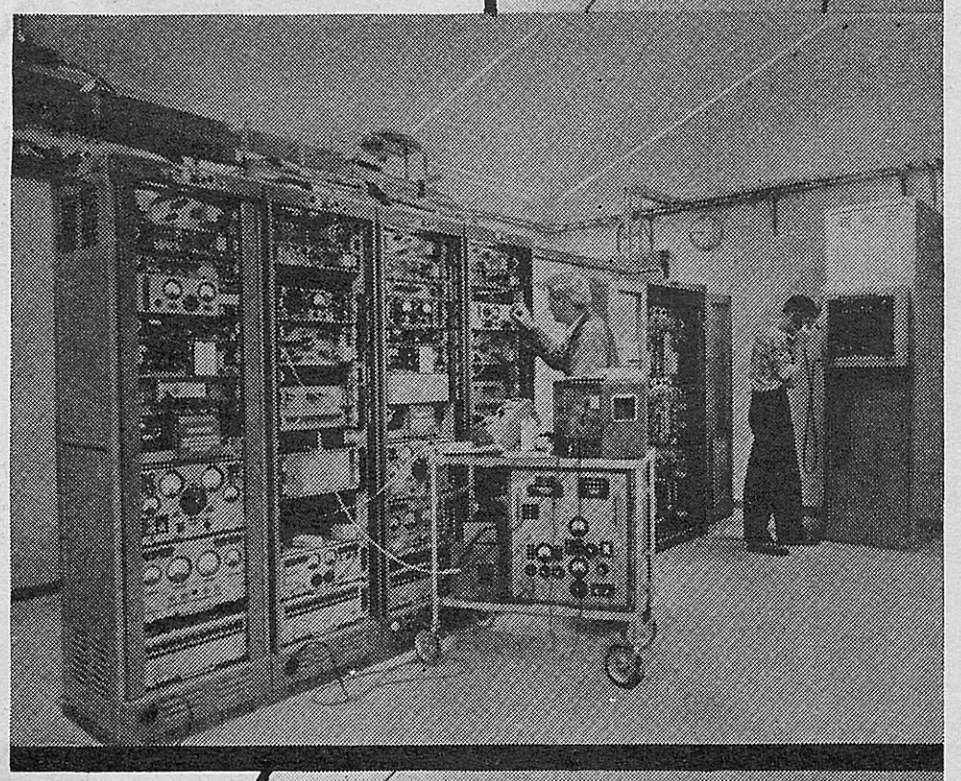

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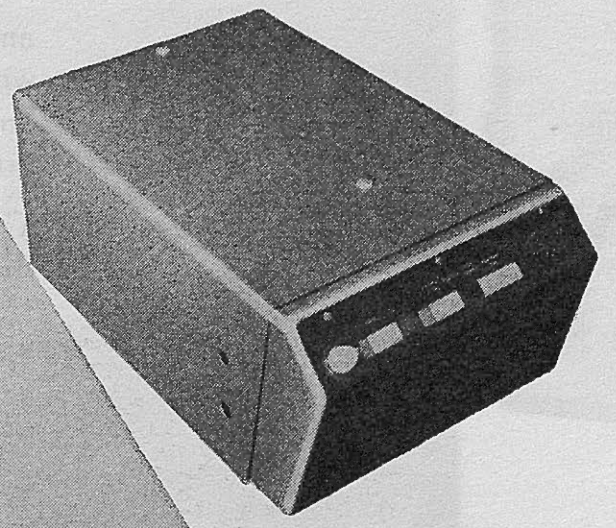

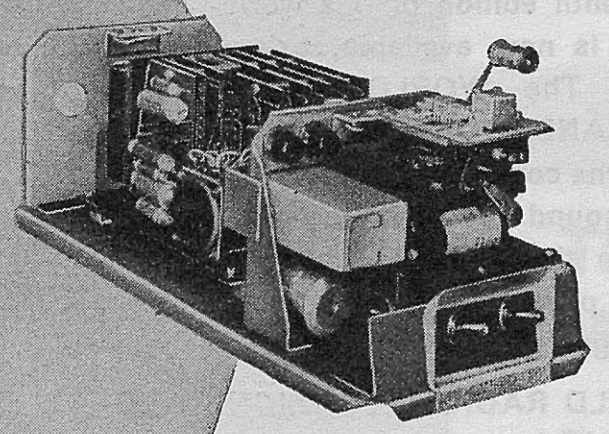

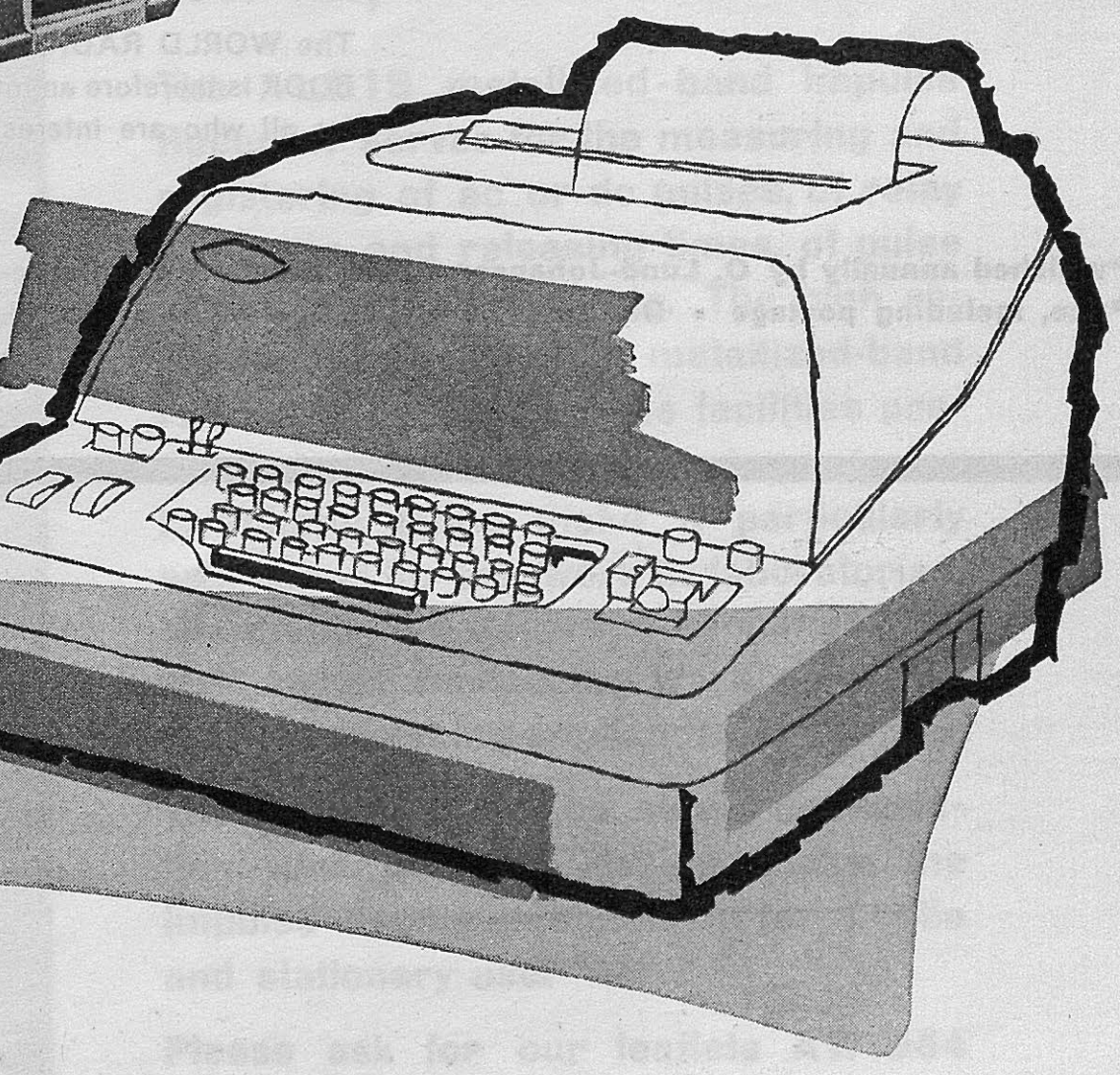

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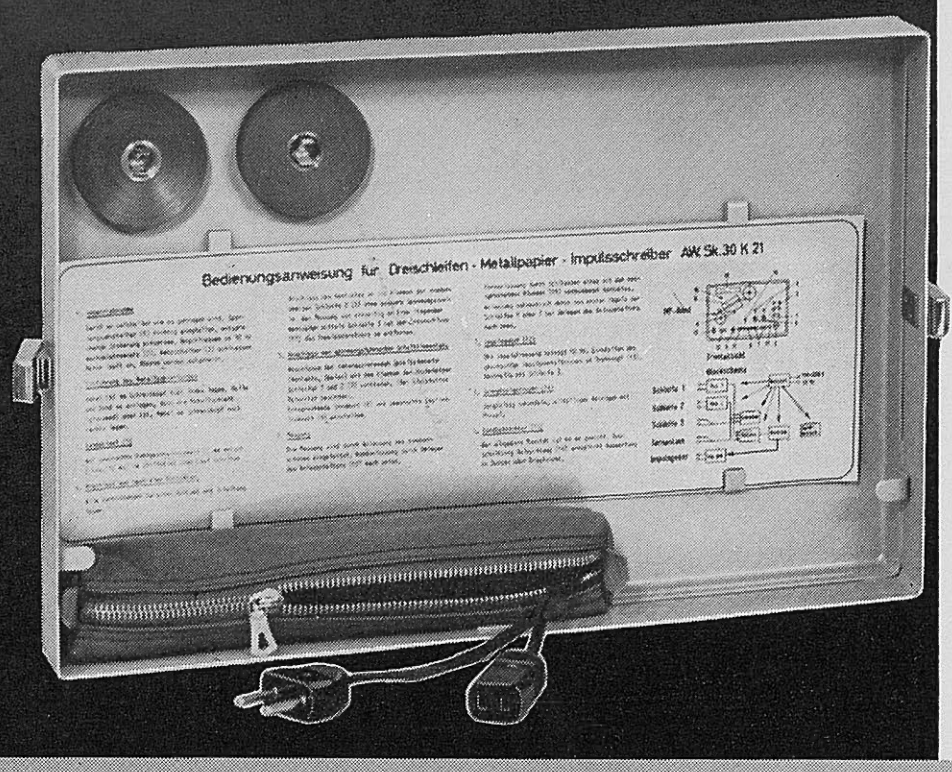
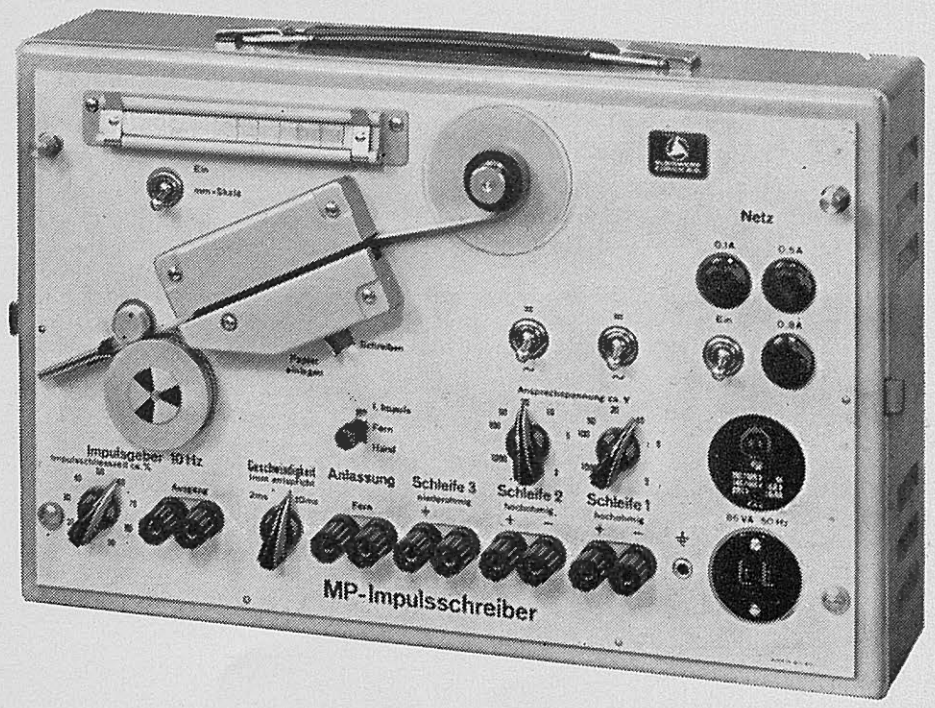
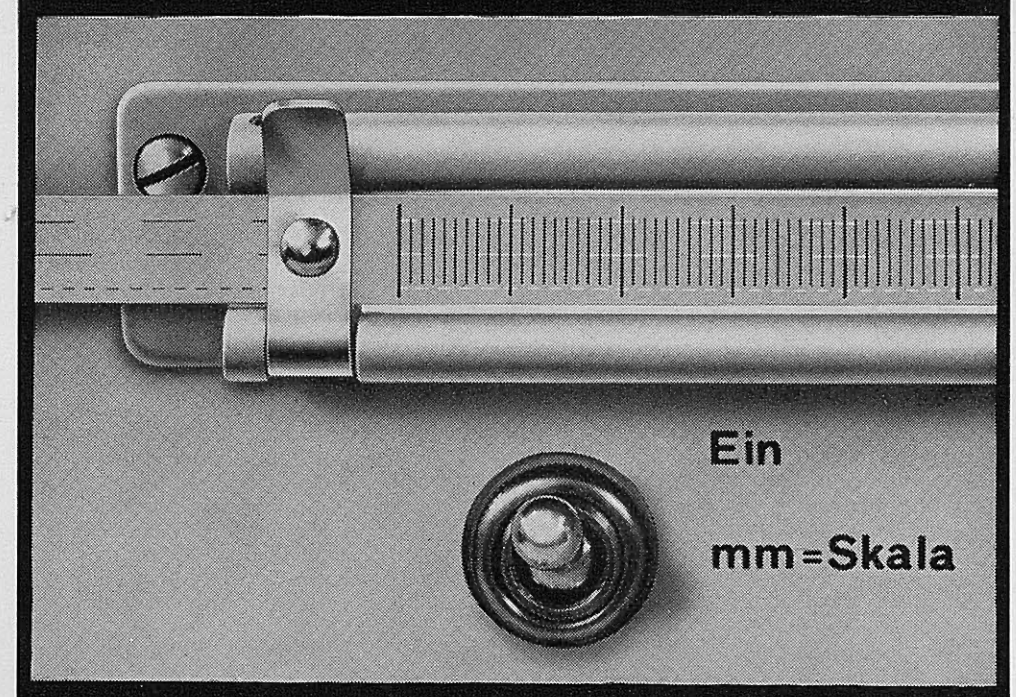




Example of a measurement on the recording band



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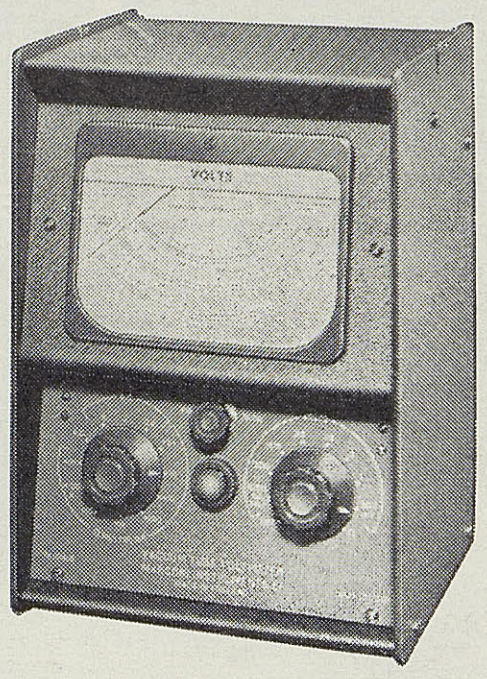

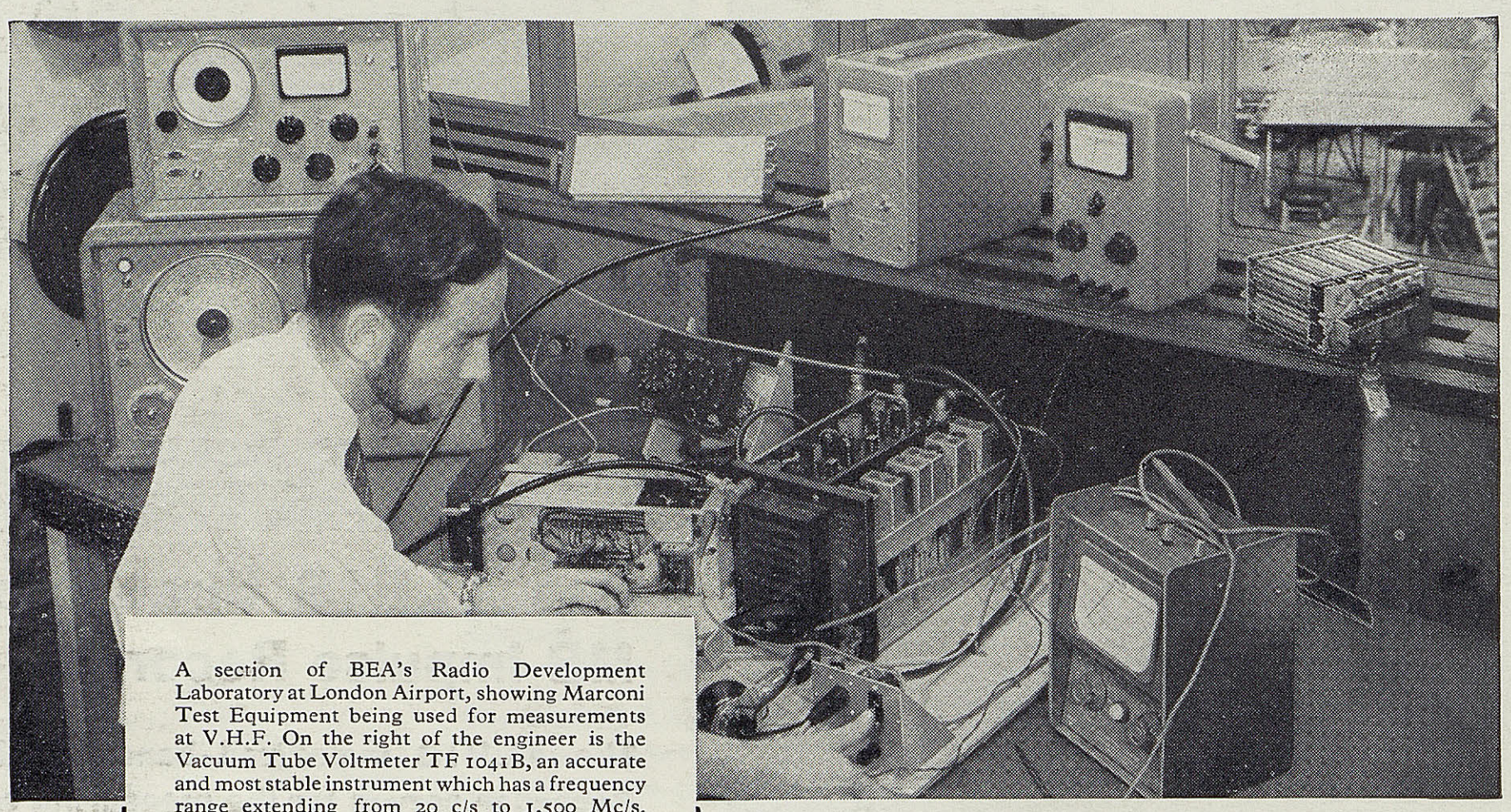

A section of BEA's Radio Development Laboratory at London Airport, showing Marconi Test Equipment being used for measurements at V.H.F. On the right of the engineer is the Vacuum Tube Voltmeter TF 1041B, an accurate and most stable instrument which has a frequency range extending from 20 c/s to 1,500 Mc/s. Measures: (i) a.c. up to 300 volts; (ii) d.c. up to 1,000 volts; (iii) resistance, 0.02 ohm to 500 MΩ. A.C. and D.C. multipliers available. For full details, please write for Leaflet E 195.

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